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Electrical World

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WITHIN the ranks of any industry of major magnitude today, there is a necessary group of technical men who are constantly engaged in the further fabrication of their industry. They are the scientific, the systematic thinkers who man the frontier line of progress and at every point continually carry on the work of evolving and putting together the physical details of growth and improvement. They are ceaselessly striving to advance the technique of the industry so that it may anticipate demands made upon it and may render a complete and conspicuous service. Outstanding in accomplishments of this kind are the technical men of the electrical industry.

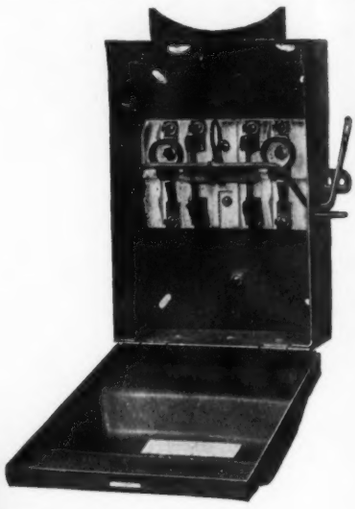
NO small measure of credit for the high character of the work of these men is due to the American Institute of Electrical Engineers. Banded together professionally, independent of commercial connections and confining their attention closely to their own peculiar field, these men have attacked their technical problems with a zeal and comprehension that has brought great benefit to the industry. While the Institute is as old as the profession, yet it is young in years and it is still in the prime of its growth as a constructive agency. The large attendance and the sustained interest in the program of the eleventh annual midwinter convention last week give striking evidence of the continued virility of the organization.

Report of the Eleventh Annual Midwinter Convention of the American Institute of Electrical Engineers

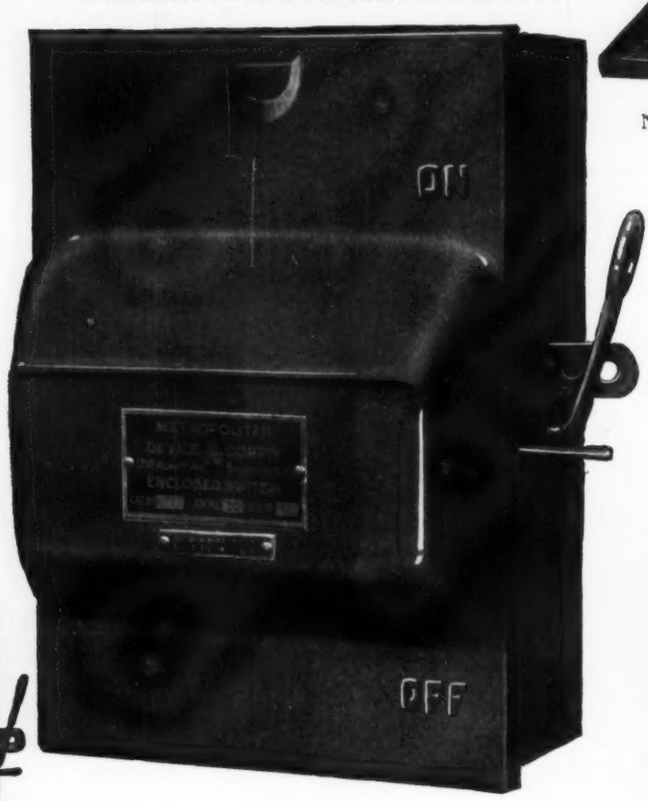
No. 130. This switch used in New Jersey

Metropolitan

Standardized Meter Switches

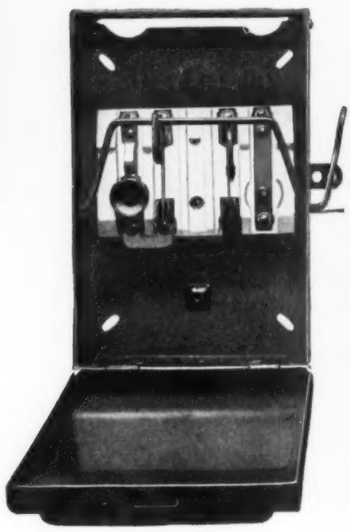


No. 330. This switch used in Brooklyn



No. 230. This switch used in Boston

No. 932. This switch used in Chicago



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Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

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W. H. ONKEN, JR. Editor

HAROLD V. BOZELL Editor

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"Say It with Facts!"

BLESSED be the man who thinks and talks with facts! He is needed in the world today, where more time is being wasted and more money spent by doing things wrong than by not doing them at all. To the man with facts life offers greater resources, greater responsibilities and more satisfying achievements than at any period in history.

We are an impetuous generation. We like to make decisions, to set tasks and see them soon disposed of. Yet success depends on judgment, and, after all, judgment is only analysis of facts. Good facts produce good judgment. Therefore the man who gathers facts and gives them active use has knowledge and judgment superior to that of better minds that may rely on personal memory and experience. For he then has the guidance of the experience of all men.

TIME was when a man's personal observation was a pretty good guide to his work. His environment was small. His contact was limited to a few immediate influences. His work concerned himself and the few folk about him. His powers and his purposes were puny in contrast with the complex relationships of modern life. He could decide things on his own knowledge, for what he did was little to the world beyond.

But cottage industries are gone and village life is now expanded into national life, and local trade has come to be a very part of the commerce that serves all peoples and is affected by unseen conditions of far origin. Thus business has grown beyond the art and craft into a science, and when we say a science we mean that it is now founded on and sustained by facts. And there has grown up in the service of industry a great group of engineers, whose function it is to evolve, interpret, and apply these facts, by trained scientific thinking.

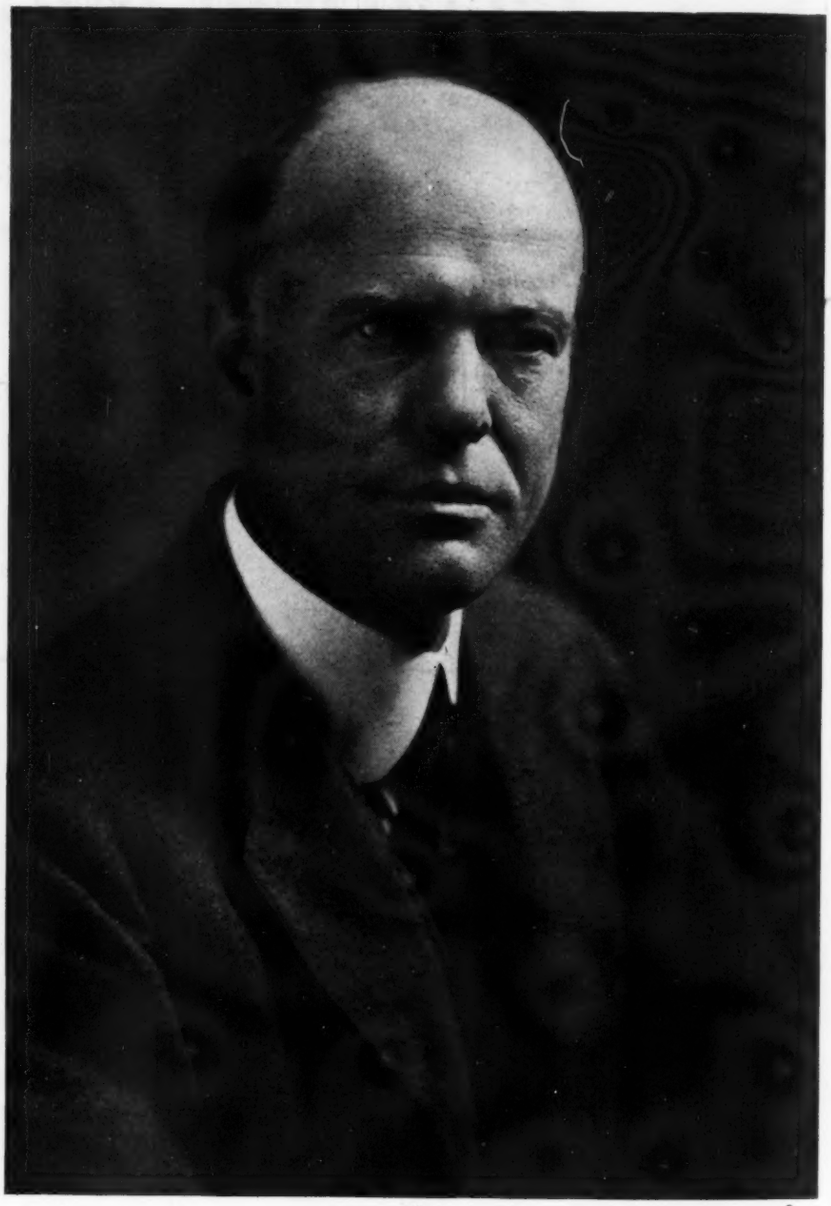
ANY modern industrial enterprise is like a ship at sea. The sea captain cannot look beyond the horizon, and so he uses maps of coast lines, readings of the sun, charts of winds and currents, laws of storms, his knowledge of his engines and his ship and makes decisions in accordance with these fundamental facts. The business executive ashore needs facts no less. But the situation lacks the element of personal risk, and so he and his men neglect to set a daily course by facts. They are inclined to guess and drift.

The electrical manufacturer and jobber, the central station, the contractor and dealer are all suffering today from lack of facts—facts on their cost of doing business, facts on the growth of market, facts on the value of different kinds of business, facts on competitive production, facts on distribution, facts on the relation of other primary industries to their own—all facts needed to help them serve. These facts must be sought out, compiled and made available that we may organize this mighty resource into each man's hourly work.

"Say it with facts!" It makes a good slogan. But the great need is first to get in hand more of these essential facts to think with. And for this vital contribution, industry looks to the engineer.

George E. Quinan

An authority on rural distribution and on safety codes governing transmission and distribution.



ONE of the most important problems of power development in a sparsely settled country is that of rural distribution. As an authority on this subject as well as in the general field of safety codes governing transmission and distribution lines George E. Quinan, chief electrical engineer of the Puget Sound Power & Light Company, has a reputation equaled by that of few men. As chairman of various committees and a member of others in the National Electric Light Association and the Northwest Electric Light and Power Association, he has helped to direct both practices and policies along these lines.

Mr. Quinan was a graduate from the University of California with the class of 1903. Even at that time he had shown much ability as an original thinker in handling technical problems. He spent two years in general field work, in Spokane, Cœur d'Alène and on Puget Sound, helping to bring in the power from Spokane Falls which was to replace steam in the silver-lead mines of Idaho. In February, 1905, he became assistant superintendent of power with the Tacoma Railway & Power Company and the Puget Sound Electric Railway.

In 1911 he became the operating superintendent of the Seattle Electric Company's properties in Seattle. Two years later he advanced to the position of superintendent of light and power with the Puget Sound Traction, Light & Power Company, Seattle division, and two years after that he was engineer of the same organization. In July, 1919, he entered on his present duties as chief electrical engineer of the Puget Sound Power & Light Company, which controls all Washington State properties under the management of Stone & Webster.

Mr. Quinan has been a student of rates for electric service, particularly in their relation to costs. He has given considerable attention to regulatory codes relating to electrical construction, also to the inductive-co-ordination problem and the economic principles underlying the extension of service to rural communities, and is today working with others toward a solution of these problems. Among his recent interests has been the development of an alternating-current underground system of distribution in Seattle.

Mr. Quinan has had an active part in the preparation and development of accounting classifications. He was associated in the design and construction of the first plant in the West for burning pulverized coal under steam boilers. He is a fellow of the American Institute of Electrical Engineers, of which he has also served as local chairman.

Editorial Comment

Electrical World, February 24, 1923

Volume 81 Number 8

A Government Department Wakes Up

NOTWITHSTANDING all the work that has been done by the Illuminating Engineering Society and by others in the formulation of lighting codes, higher intensities of illumination are still the exception rather than the rule. Business people recognize the value of good lighting, and it is not uncommon to find show windows and stores well illuminated. Eight states have adopted factory lighting codes stipulating the minimum foot-candles required as a matter of safety in industrial plants, but municipal, state and national governments are slow to move. Street lighting, for instance, is far from adequate, although it is the one service that benefits every taxpayer. However, there is balm in Gilead. A ray of light has penetrated the Post Office Department and brought with it a consciousness of the economic advantages of increased illumination.

By the adoption of a standard system it was discovered that the efficiency of the postal workers was increased 4.4 per cent. It is therefore recommended that the Postmaster-General install this standard system of lighting in all post offices. If universally adopted throughout the United States postal system, the new lighting rule will effect a saving running into millions of dollars. We are not, however, so much concerned about this sudden manifestation of thrift on the part of the Post Office Department as we are about its recognition of the principles of proper illumination. Let us hope that this recognition will percolate through to other departments of the national government and on through state and municipal governments, so that the general average of civic illumination throughout the country will be heightened considerably. Certainly better illumination is sorely needed.

Midwinter Convention of A. I. E. E. a Splendid Success

THE midwinter convention of the American Institute of Electrical Engineers has established itself as an occasion for interpreting and presenting to the electrical fraternity new discoveries and accomplishments in the theoretical aspects of electrical engineering. The convention of last week exceeded those of the past in the numbers attending, in the interest aroused by the program, in the diversity of subjects and in the number of papers presented.

Apparently there has been a rejuvenescence of interest in the theory of electricity, which can be attributed largely to the fact that the practical problems now facing the engineers in their larger engineering projects call for advanced theoretical knowledge to bring about their correct and economical solution. In many branches of the electrical industry renewed activity is noticed, and the effect of the war and the industrial depression no longer limit expansion and progress.

Conventions such as this which serve to interpret, to apply and to record technical advances in the art, and which strive to stimulate research through rendering public homage to the specialists, are valuable to the electrical industry in even greater degree than those which exist for social purposes or for discussing commercial or engineering practices. All who attended the midwinter convention must necessarily have been stimulated and keyed to a higher pitch through meeting the leading specialists in the industry and hearing them describe the technical developments in their fields.

The study of electrical phenomena, aside from its bearings on the material wants of man, affords a wonderful opportunity for masterly reasoning in applying the mind to intangibles. No other branch of science calls for keener or more intensive inductive and deductive reasoning, and no other branch so directly applies theory to practice. Notable work has been done in electrical science, but even today, as manifested in the paper by Dr. Carl Hering and the resultant discussion, there is far from general agreement as to the physical nature of electricity or magnetism. In spite of this fact, engineers and scientists have developed mathematical relations and stated fundamental laws which serve to give quantitative solutions to nearly every problem associated with the application of electricity. These accomplishments prove that the electrical engineer has a mind which recognizes and appreciates the reasoning and experimentation of specialists in the various fields, and the large attendance at the convention and close attention given the speakers give added weight to the assertion.

A feature of the convention this year was the many papers on communication. Radio and wire telephony have established new records, and the large audiences that heard the papers recounting these achievements proved that communication is no longer of interest only to a small group of specialists. The vacuum tube also showed still wider fields of application, these being brought out by the paper on the crest voltmeter and the lecture on the pallophotophone.

It was fitting that the first joint session of two bodies of engineers separated by nine hundred miles should have taken place at this convention. Chicago and New York electrical engineers discussed their problems together by the aid of telephone lines and "loud speakers," while many thousands of others, if they so desired, could also hear the program through the agency of a broadcasting station and home radio receiving sets. A new advance in the art of communication has been made, and its results on national social progress cannot be gaged. The next presidential campaign may find political leaders addressing 70 per cent of the people at one time by word of mouth and from one location, and perhaps members of this audience may question such speakers directly, independently of distance.

Metering has become a very complicated and rather

unsatisfactory field for engineers, but the papers at the convention brought out the fact that researches are under way which give promise of a simplification in mechanism and greater accuracy in measurements. Metering is a difficult field for engineers to obtain results in because it is so largely controlled by rate making—the engineers must produce meters to operate under complicated rate systems. It seems almost impossible—or at best very expensive—to construct any mechanism to take into account alike demand, off-peak conditions, kva., condition of balance, power factor and time. Much thought will be required to gain a correct solution of the problem.

In the realm of electrophysics the convention had some notable research contributions, and a great deal of interest, together with some amusement, was occasioned by the discussion between the disciples of Maxwell and their opponents. Controversial opinions may serve to bring out new quantitative facts which will advance the art.

In the matter of social features and visits and excursions to points of interest New York showed its many advantages for a winter convention. The large attendance attested the popularity of the location. On the whole, the midwinter convention just closed was the best ever held by the Institute.

Transformers of Low Core Loss an Embarrassment

THERE has been a great deal of talk about the development of special low-core-loss transformers for use in rural electric service. Some tests made recently at the Iowa State College by Prof. Frank D. Paine indicate that transformers designed for low core loss introduce not only a low-power-factor problem that is undesirable from a system viewpoint but also a metering problem if master meters are used on such lines. The tests were made on a line operating at 2,300 volts and 25 cycles. Fifteen per cent of the energy shown by the master meter could not be accounted for. On a 1-kw. transformer tested the loss was found to be 16.5 watts, but the exciting current was 1.7 amp. on the low-voltage side, or nearly 20 per cent of the full-load current. The exciting current for the entire line was 3.2 amp. on the 2,300-volt side, and the full-load current during maximum demand was 6 amp. The power factor on the line during the day ran as low as 7 per cent. For about twenty out of twenty-four hours the power factor of the line was very low. The net result was the throwing of a large error on the master-meter readings.

The situation revealed in this case is an indication of the care needed in considering modifications of existing apparatus to meet new conditions. On the face of the proposal a transformer of low core loss seems reasonable for present rural electric service requirements and it has had some enthusiastic support. If it introduces other complications like those indicated, it may not be worth while to spend time and energy on the design of a new line which will also complicate the present transformer situation by adding another transformer to those already called standard. Both the manufacturers and the users have spent much time and energy in reducing distribution transformers to a basis that will keep the manufacturing situation within reasonable bounds. There should be a sound basis for the addition of any new types to the present list.

How a City Gains by Better Street Lighting

ONE OF the certain benefits of better engineering is profit to all who are concerned. However pecuniary benefits may be divided, everybody wins in improved and more reliable service and in the consciousness of bettered conditions. An analysis, for example, of the effect of the improved street-lighting methods in Kansas City described in the Feb. 10 issue of the ELECTRICAL WORLD will bear out this statement. First of all, the city wins heavily in quantity and quality of lighting, especially when one reduces the situation to cost per candlepower-hour or its equivalent. This is encouraging of itself, but to it are added certain intangible assets which do not appear on any assessor's books but which must not be forgotten in the audit. A very large amount of service has been put underground, which not only greatly lessens the chance of the system being crippled by storm, but makes for a better-looking city, with a general increase of values. Not even the most hardened electrical man likes the appearance of overhead wires. They are an economic necessity in sparsely settled districts, where it is that or nothing. Abroad, under similar conditions, it is generally nothing, or its nearest approximation, paraffin. But when, as here, a decently economical underground system has been laid out overhead wires must go, with a chorus of "Good riddance!" In this case the distribution system adopted, with the constant-current transformers out of doors on the poles, makes it possible, too, to dispense with a large amount of what would otherwise be dead wire.

Aside from this gain in appearance, there is the effect in maintaining public order, which, as a result of experience, has been shown to be very important. In these days, when crimes of violence run rampant, the old adage that an arc light is as good as a policeman takes on a new significance. One rarely hears of a hold-up in the full glare of a street lamp—daylight crimes are familiar, but it is an unusual brand of thug who picks out a victim in the most conspicuous place on the street.

Good service at reasonable cost means plentiful lighting, and there are few better investments within reach of the community. And, as these recent schedules show, the investment is by no means heavy compared with the benefits conferred. In addition, in the Kansas City case, there is full provision for the taking over of the system by the city on a definitely stated basis. But, in point of fact, there is no reason to believe for a moment that the citizens want to take a chance on municipal ownership even on the very reasonable terms made possible. The contract leaves little room for dispute even in the often troublesome matter of depreciation, and, starting from the beginning of a new development, the original cost and the costs of additions are determinable.

What does the operating company gain? A better and more economically operated distribution system; a contract which, if disturbed at all, is affected only in ways known from the start, and, more than all, the confidence of the citizens that they are getting fair play and an honest accounting. Not one voter in twenty can form a clear idea of the merits of an old and often changed agreement. Here the voter can start fresh and see plainly that he is getting full value for his taxes. The sentiment of mutual fair dealing is the best security for the city and the best assurance of prosperity for

any operating company. It is feasible and profitable thus to play with the cards on the table, the only real stake being an open rivalry for the betterment of the city and prosperity of its industries, equally important in the long run for citizens and utility companies alike.

Money Spent for a Good Cause

THE past week has witnessed scare heads in the daily press over the reports of and comments on legislative investigations in regard to expenditures by utilities necessitated in fighting vicious legislation. Particularly has this been true in California, where a special committee of the State Senate has been holding open sessions in San Francisco looking into the expenditure of money to defeat the proposed water and power act at the election last November. Virtually all of the prominent electric light and power men in that state have been called to testify before this committee, and it is a source of great gratification that they met the summons with complete frankness, although it was generally considered that they were not legally bound to appear.

Not only are they to be congratulated upon the frank presentation of the facts which they made, but also upon the firm stand they took in the matter of the use of their own money in proper ways to fight vicious legislation whenever it is threatened. This right they steadfastly insisted upon in view of the fact that the securities of more than a hundred thousand citizens of California are put in jeopardy by such attempts. Self-preservation has ever been recognized as the first law of nature, and in all things that make for or against the continued prosperity and usefulness of the electrical industry there is no exception to this law.

Loop Distributing Circuits of Higher Voltage Needed in Some Places

THERE are some indications that the limit to the amount of power that can be distributed in a given city area from low-voltage street circuits is being reached. With greater and greater concentration of load in big buildings the problem of finding street room for either overhead or underground circuits is bound to become increasingly acute. In the past many companies have in congested districts followed the policy of leasing substation sites. Sometimes these have been basements of buildings so located that considerable areas could be served, and sometimes they were tracts of land on which structures were erected. But it is now not infrequently found difficult or impossible to lease building space, and where it can be leased the term of years is such that expenditures for substation equipment of any large capacity and provision for growth are economically impossible. The purchase price of land in such areas is on a basis that prohibits the acquirement of a large number of sites. As a matter of economic necessity it appears that a way must be found to decrease the number of circuits used for street distribution systems, the number of substation sites and the amount of substation apparatus, if any extensive development in the direction of load concentration in city areas is to take place in the future.

In one rather prominent case where a low-voltage direct-current substation layout is being revised the plans adopted were not carried into effect before new building projects in the area served created a problem that was solved only by taking the new building service from high-voltage alternating-current circuits that happened, for other reasons, to form a loop around the district. The lighting and general power service is in this case given through ordinary step-down service transformers, and the elevator service is provided with direct current through motor-generator sets. The direct-current substation rearrangement is being carried out in the district referred to because it will take years to eliminate the low-voltage distribution system, yet the plan and means for eventually supplying the whole service from high-voltage alternating-current circuits is provided and the low-voltage service will eventually be eliminated.

In another case the lack of room for overhead circuits is forcing the substitution of 13,200-volt circuits to serve industrial load that has hitherto been served at 2,300 volts. Similar instances could be cited in great number. The point is that radical changes in the method of approach to the problem of distribution in congested areas face the engineer. Nor will it pay to consider only the present problem; plans for such areas must be made with adequate consideration of probable development well into the future.

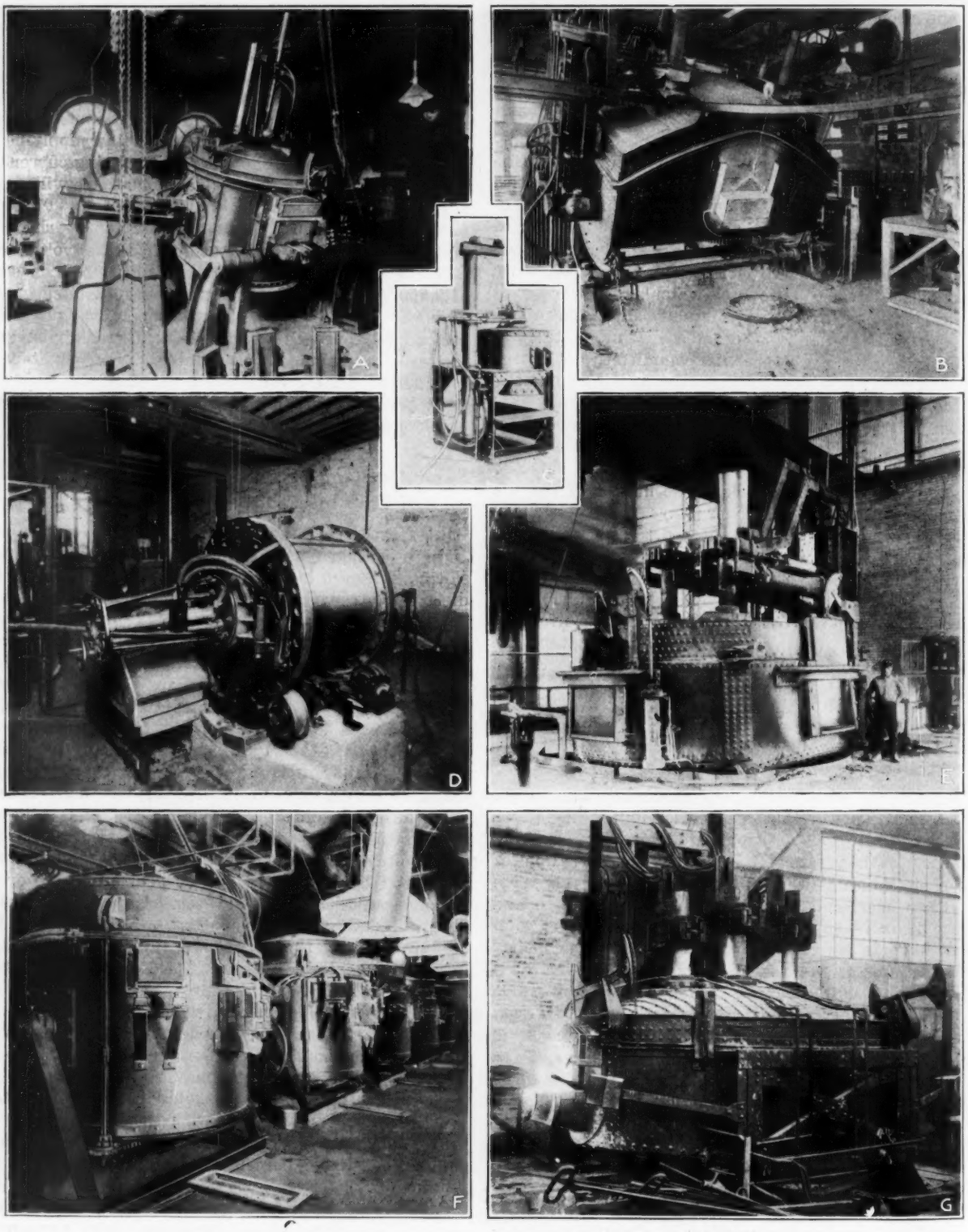
Some Outstanding Problems of Line Insulation

JUST at present the insulation of lines for the extra-high voltages now coming along seems to develop slowly. We need higher mechanical qualities and higher dielectric strength if the future's demands are to be met. In particular we need to make more skillful use of the best materials that are available. The shielding or grading of strings of insulator disks so that the burden will be equalized is perhaps the most important step that can be taken immediately. Its usefulness has been well demonstrated, but full advantage of it has seldom been taken. It has been called "theoretical," or some similar attribute favored by the conservative as most derogatory to radicalism has been ascribed to it, although, on the other hand, it ought to be self-evident that it is unwise to load the entire burden of supervoltage on one or two elements of the string.

Apart from this feature of suspension design or disk arrangement, there should soon be advances in the strength and specific insulating qualities of the individual disks. Perhaps the most radical line of advance is toward the use of pure fused silica-quartz glass, instead of ordinary glass or even porcelain. Fused silica has, if homogeneous, very high insulation and mechanical strength, and on account of its low expansion it is remarkably free from annealing strains. Just what its best economic use may be remains to be seen —whether shorter strings should be used, or smaller disks, or composite strings with the silica bearing the heavy duty. Meanwhile there are promises of denser and more reliable porcelain which will presently play its part.

The one thing certain is that with the coming of supervoltage systems—and their tread is rather cautious —there will be need for every precaution against failure to deliver the goods, so that line building and insulation take on new importance. In such work question may well arise as to whether the several phases should not be carried on separate steel-pole lines instead of the ordinary system of towers carrying double circuits. The object to be sought is the utmost possible immunity from interruptions of service, quite irrespective of precedents, which are too often mere enemies of progress.

Electric Furnaces Produce Quality Products



THE drastic specifications for materials, the elimination of waste in their production and the reduction in available labor for operation have given new impetus to the application of electric furnaces in melting and treating brass and steel.

Various types of furnaces are available and a great development and improvement has occurred in the control and regulating equipment so that the furnace now affords a splendid load for central stations. The photographs show several types of brass and steel furnaces. A is a Rennerfelt furnace for brass melting. B is a contact arc resistance furnace also used for brass melting, while C is a Repel-Arc type. D is a Booth rotating-type brass furnace. The Heroult furnace, E, and the Vom Baur furnace, G, are used in steel making, while F is a Bailey resistance furnace.

Eleventh Midwinter Convention of the A. I. E. E.

Large Attendance and Sustained Interest Mark the 1923 February Gathering—Papers Presented Recount Technical Advance Along Various Lines

THE eleventh midwinter convention of the American Institute of Electrical Engineers was, judging from the attendance and the spirit evinced in the meetings, one of the most successful ever held. The official registration was nearly 1,150, and many more attended the meetings, the smoker and the annual dinner-dance.

Altogether, six technical sessions were held, one Wednesday afternoon, two (parallel sessions) Thursday morning, one Thursday afternoon and one each on Friday morning and afternoon. A joint two-city, radio-broadcasted meeting was held Wednesday evening, as reported in these columns last week. A well-attended smoker was given Thursday evening, with the New York Section members as hosts. In addition to the entertainment features on this occasion C. A. Hoxie of the General Electric Company described and demonstrated the "pallophotophone," an arrangement for oscillographic record of speech, music or other sound to be transmitted later electrically by light-sensitive cells to various loud-speaking devices, radio transmitters or other instruments. The application of this pallophotophone to motion picture films was pointed out, the result being the "talking movie." The great advantage of the pallophotophone is the purity of record and voice reproduction, none of the inherent characteristics of microphones or wax records and other mechanical contrivances being involved. The pallophotophone works on the principle of recording on a moving film light beams from an extremely small mirror, mounted to follow the motions of a diaphragm on which the sound falls. This film is later passed in front of another light beam so as to affect the light falling on a "light-sensitive" cell, which in turn varies the current to correspond with the original voice waves. Audion tubes and other already familiar devices do the rest.

The dinner-dance on Friday night, which closed the convention, was the best attended in the history of this annual function, there being nearly six hundred guests.

In the following pages an extended report of the meetings is given, including abstracts of papers presented (most of which have already appeared, or will appear very soon in the Institute's *Journal*) and the discussions thereon.

Wednesday's Session Devoted to Progress in Transmission and Distribution

The report of the cable research committee, which constituted the major part of the report of the transmission and distribution committee (E. B. Meyer chairman), was presented by D. W. Roper. He referred to the marked reduction in dielectric loss in cables, improvement in dielectric strength, reduction in thickness and increase of insulation resistance. It is now possible to get lead-covered cable with impregnated paper insulation and with a dielectric loss so low that the limiting temperature is that which will cause permanent deterioration of the insulation. To operate underground cables at the temperature specified by the A. I. E. E. rules, it would be necessary to operate them at such a very low current density that it would be uneconomical. Higher current densities would require operating the cables at temperatures considerably higher than those permitted by the Institute rules. However, this is being done already without signs of deterioration.

In the past there has apparently been considerable confusion between troubles caused by dielectric losses and troubles caused by dielectric stresses. Cable failures due to dielectric stresses are quite rare. Engineers are not in accord as to the maximum permissible dielectric stress nor as to which dielectric stress is the limiting feature in high-tension cable design and operation. They can, however, be guided by the stresses that exist in cables that have been in successful operation for a number of years.

From a comparison of insulation thicknesses on American and foreign cables it may be noted that the ordinary English practice is appreciably below the minimum recommended by any American manufacturer, and also that the recent thickness adopted by one English company for a 20,000-volt cable is 25 per cent below the previous practice and about 30 per cent below ordinary American practice. In Italy the high-voltage cables apparently have about the same thickness of insulation as is used in this country.

According to the best information obtainable, the English operating companies carry about the same load on various sizes of three-conductor cables as is customary in this country, but because of the improved facilities for radiating heat the maximum operating temperature of copper is about 50 deg. C. If cable bells are not to be the weak feature, they should be able to withstand as high overpotential stressing as the cable. If it is impossible to go materially above 200 kv. in a three-conductor cable bell, then a limit may be placed on three-conductor cables at about 40 kv.

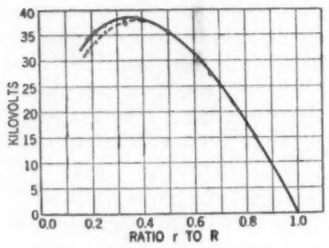
Leading American manufacturers have gradually changed from vegetable oil impregnating compounds to those with mineral-oil bases, and practically all are now using the vacuum process of drying and impregnating. One foreign manufacturer is using a thin transformer oil, but the lowest losses reported with its use are not materially below the minimum losses which have been reported by one American manufacturer using a mineral-base compound.

According to tests, it appears that if the impregnated paper insulation will withstand, say, a thousand double folds in an endurance test, then the cable will pass the bending test without difficulty.

Owing to the fact that the sheath current in single-

conductor cables may reduce the carrying capacity of the cables 10 or 15 per cent, the losses in the current in the sheath must be taken into consideration in calculating the efficiency of transmission.

Referring to the maximum voltages at which underground cables are being operated in foreign countries, Mr. Roper pointed out that while a number of them are rated at very high voltages, most of them are operating below rating. At least one of the cables, however, is operating at 33,000 volts, one three-conductor cable of this rating having been in operation since 1914. A single-conductor cable at Barcelona, Spain, has been in operation at 50,000 volts since 1914 without any cable failures except one caused by electrolysis. The highest-voltage cable in this country is a 30-mile section operating at 33,000 volts in Chicago. No failures have occurred since it was installed, but it has not been operated at the limiting voltage. Some new cable will be installed there shortly which will be operated at 44,000 volts, to serve as a station tie line permitting two-way exchange. The high-voltage joints will require 3-ft. to 4-ft. sleeves, necessitating special manholes.



RELATION BETWEEN RUPTURING VOLTAGE AND THE RATIO OF THE CONDUCTOR RADIUS TO THAT OF THE DIELECTRIC

The transmission and distribution committee report read by E. B. Meyer stated that the outstanding features of present overhead construction are the continued tendency toward higher voltages both in transmission and distribution and the improvements in construction methods as a result of standardization in the materials and design. In a general way it can be said that the manufacturers have made good their claims of several years past that insulators of the latest manufacture are not subject to the rapid depreciation which was the cause of such concern a few years ago. Engineers who have given the insulator much study believe that the insulator unit for 220 kv. should be larger so that the number of units may be reduced to about the same number as now is used for 100 kv.

It is interesting to note that the Southern California Company already has 27 miles of one of the Big Creek lines in operation at 280 kv. and 240 kv. for experimental purposes. Increased loads and areas covered have finally made evident the inadequacy of the customary 2,300-volt and 4,000-volt circuits for many distribution problems, with the result that 6,600, 11,000 and 13,200 volts and higher voltages are now entirely standard in many districts for purely distribution purposes.

With a relatively steady increase in density of Edison loads, it has been found desirable to increase the size of the meters and conductors to as large a figure as may be installed safely or as the existing ducts will admit. A very decided point in favor of cables containing pressure wires is that they permit the adoption of junction-box or terminal circuit breakers for automatic isolation of faults.

Considerable divergence of opinion exists regarding the type and size of cables to use in Edison mains, the location of boxes and the fusing of meters and mains.

The use of direct potential rather than alternating potential for high-voltage stress with installed cables is being investigated by operating companies. Even where sufficient power is required to reduce the faults or failures so that the trouble can be located, the cost of the apparatus is said to be only about one-quarter of the cost of alternating-current testing equipment. Foreign investigations indicate that the ratio of direct current volts to alternating-current volts to produce the same test results should be two and a half to one, but American manufacturers up to the present time have not been willing to agree on a ratio higher than one and a half.

Foreign practice in transmission and distribution was also outlined.

Apparent Dielectric Strength of Cables

Although a great many investigators do not believe in free ions in solids, said Robert J. Wiseman, it is remarkable how well computed results agree with experimental data, if it be assumed that they do exist and that the laws of ionization can be applied. The ionization theory has been applied by the author satisfactorily to all data made available so far. According to these comparisons, the author contends that the law $V = K_r [1 + (a/\sqrt{r})] \sqrt{R}\, r \log R/r$ is applicable to all ratios of conductor radius to insulation radius.

Since there is no independent evidence of the free mobility of ions in solid dielectrics, Dr. J. B. Whitehead urged hesitation in explaining cable failure in terms of ionization theory. Despite the fact that the law has been found for breakdown of gases and a theory has been developed, no one is in a position to say exactly what takes place in the gas under these conditions. Therefore, with the inconsistent results obtained in cable research, one should be still more cautious in assumptions.

Mr. Davis maintained that greater variation in results was obtained by Wiseman's method than by Middleton's method, citing 60 per cent maximum variation for results with Wiseman's method and 19 per cent with Middleton's. Mr. Wiseman agreed that engineers should go slow in applying the theory of ionization to cables, but contended nevertheless that there is some agreement with this theory in cable breakdowns.

Short-Circuit Currents in Power Networks

The merits and limitations of the short-circuit calculating table were discussed by O. R. Schurig, who considered its proper field of application, its accuracy and the methods of using it. Its chief field of application, said the speaker, is in making polyphase short-circuit current calculations required for the selection of oil circuit breakers, in the determination of relay settings and in the layout of distribution systems. It is not generally applicable to phase-to-phase short circuits or to phase-to-ground short circuits, on account of the unbalanced current division among the phases. These problems must be solved by calculation or by alternating-current tests.

The errors of the short-circuit calculating table are due to the neglect of capacity-charging currents and to dissimilar impendance angles occurring in the various elements of a network. The former is almost always negligible for polyphase short circuits, being smaller than 10 per cent for a three-phase short circuit occurring in an aërial line 200 miles from the generator.

In a great many systems the resistance component of all the impedance may be entirely neglected for short-circuit determination. This method, the reactance

method, generally gives erroneously high current values. The errors are safely below 20 per cent, and commonly under 10 per cent, under the following conditions:

(A) In systems in which circuit elements of dissimilar impedance angles occur in series connection only (*i.e.*, parallel-connected circuit elements having impedance angles less than 15 deg. apart), provided the circuit constants are within a definite range of the following character:

(1) Generating-station reactance not lower than distribution-system impedance and angle of the latter not lower than 30 deg.

(2) Generating-station reactance not lower than one-half the distribution-system impedance and angle of the latter not less than 45 deg.

(3) Generating-station reactance not lower than one-fifth of distribution-system impedance and angle of the latter not less than 55 deg.

(B) In systems not covered by (A), provided that all impedance angles are larger than 55 deg.

For systems not covered by the range of circuit conditions defined above, but having impedance angles not materially below 30 deg., the impedance method is preferable and gives errors well below 20 per cent and commonly below 10 per cent. The short-circuit current values are generally low. Cable systems with current-limiting reactors in some of the lines come within this class. While the impedance method is particularly suited to systems having parallel-connected circuit elements of widely dissimilar impedance angles within the limits stated, it is not a substitute for the reactance method in systems of type (A) and (B).

R. A. Doherty called attention to three major sources of error in using calculating tables for short-circuit calculation, namely, the generator reactance, the calculation tables and the use of decrement curves. He referred to the tables as a means of determining the most desirable distribution system and behavior of generators under transient conditions.

G. M. Armbrust referred to a new alternating-current calculating table developed in Chicago which is intended to enable study where large impedance angles are involved but is not intended to replace direct-current board.

Qualitative Analysis of Transmission Lines Not Sufficiently Accurate

Basing his discussion upon a previous presentation by Percy H. Thomas, H. Goodwin, Jr., introduced the "critical load" as a means of qualitatively analyzing transmission lines and gave a simple formula for determining this load and the effect of variations of power factor, voltages, etc. The effect of various line constants upon the critical load were briefly discussed. Working from the critical load, a vector interpretation of the action of a long high-voltage transmission line was given. From this vector interpretation it is possible to predict certain essential operating characteristics of transmission lines. To show the applications, two practical examples were selected and solved.

Some of the properties of the critical load which are useful in analysis of transmission lines of present commercial lengths are as follows, the speaker said:

(1) The critical load when placed on a transmission line at unity power factor will be transmitted at unity power factor. The current will be constant throughout the line. The voltage drop will be the same as for direct current (IR). The power loss will be equal to the direct-current power loss (I^2R).

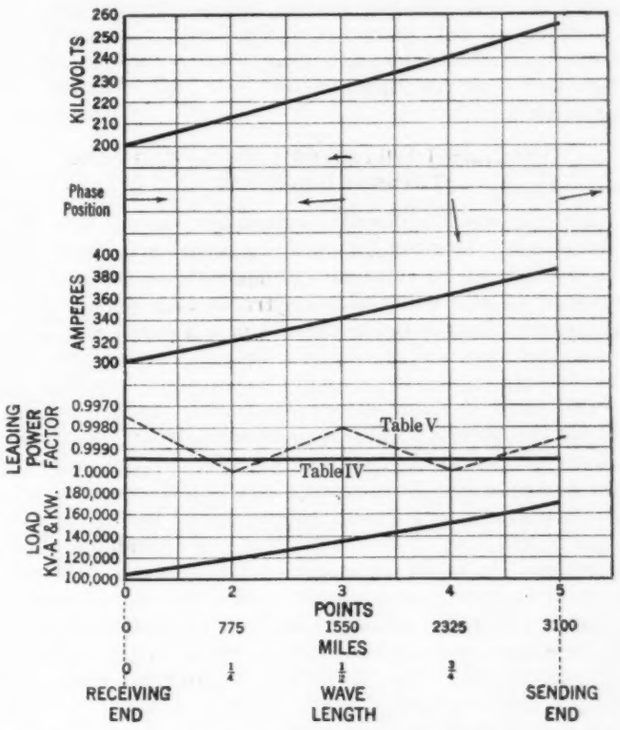
(2) If the kva. load is greater than the critical load, the power factor at the sending end of the line will always be more lagging than the power factor at the receiving end of the line.

(3) If the kva. load is less, the power factor will always be more leading than that at the receiving end of the line.

(4) If the load is the critical kva. but at a leading power factor, the power factor at the sending end of the line will be still leading but nearer unity.

(5) If the load is the critical kva. but at a lagging power factor, the power factor at the sending end will still be lagging but nearer unity.

From the formula for critical load, which is kva. $= 1{,}000\ E^2/\sqrt{L/C}$, it is evident that an increase in the



OPERATING CHARACTERISTICS OF A VERY LONG TRANSMISSION LINE SHOWING HOW THE POWER FACTOR VARIES WITH DISTANCE

capacitance of the transmission line will increase the critical load, whereas an increase in the reactance will decrease it. For lines of very high voltage the full loads will correspond quite closely to the critical loads, but light-load conditions often present greater problems than full load.

All of the discussion on Mr. Goodwin's paper was in the nature of requesting qualification of statements and proof of assumptions. R. D. Evans differed with the author regarding the conditions for most efficient transmission and stable operation, saying that conditions would be better at slightly lagging power factor rather than at 100 per cent power factor. Professor Karapetoff maintained that Mr. Goodwin should qualify his statements and prepare an appendix to accompany the paper proving the assumptions made. He pointed out that the critical load is dependent on the line constant as well as on voltage and current. Furthermore, the current is not the same at all points on the line and may be simultaneously lagging or leading, depending on the point at which it is observed. Dr. Steinmetz contended that the entire reasoning in Mr. Goodwin's paper is approximate, because it is based on the assumption that the surge impedance is equal to the square root of L divided by C instead of the square root of X divided by Y.

Mr. Goodwin replied to these remarks by saying that for commercial lines the surge impedance differed only

a fraction of a per cent from the square root of L divided by C and that the rules for calculating the critical load apply only to commercial lines. He pointed out that the purpose of the paper was to determine electrical characteristics of the line and not the economics of the situation, which must depend upon Kelvin's law. The paper was intended only to show what loads can be placed on lines to give stable operation. At the critical load no synchronous condensers are needed on the system. If greater or less load is carried, then condensers or reactors will be required for loading the system. However, unless long high-voltage lines are operated at 100 per cent load factor they are not feasible, he contended.

KINEMATIC DEVICE FOR CALCULATING LONG TRANSMISSION LINES

An ingenious kinematic computing device was displayed and described by Prof. V. Karapetoff which can be quickly set to represent vectorially the voltage and current of any point of a long transmission line with uniformly distributed constants and a given load. Its operation is based on the fact that the current or voltage at any point in a long transmission line may be represented by two vectors rotating in opposite directions and varying in length according to the fundamental differential equations of a line. The parts of the device are made to assume at will different positions corresponding to different points on the line. The constants of a line to be represented are adjustable and a complete set of performance curves can be obtained. Conversely, by a few simple trials, the best constants of a line and the necessary kva. of a synchronous condenser may be found to give the required performance characteristics. The current, the voltage and the power factor can be read directly from the device for any desired point of the line.

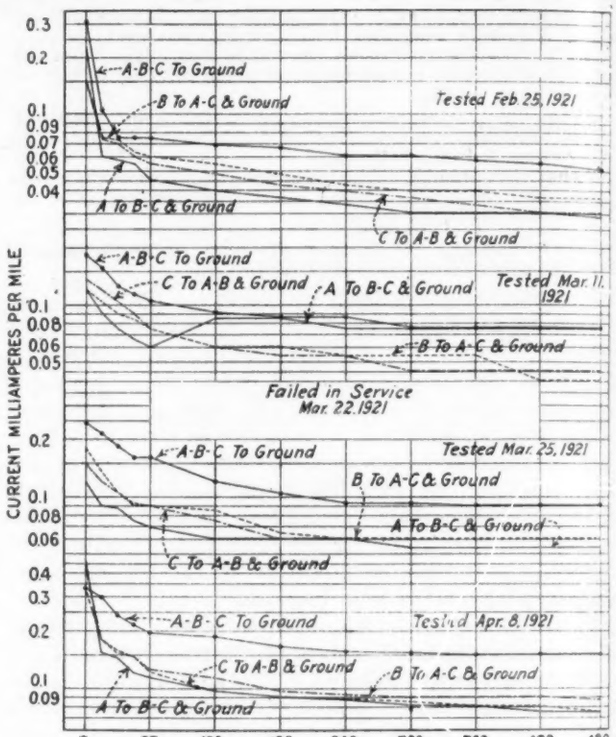
Two practical examples were calculated by this device and by means of hyperbolic functions of a complex variable, with very close agreement.

ROUTINE TESTING FOR IMPENDING CABLE DETERIORATION

In an effort to develop a routine test which will serve to detect an impending fault in underground cables, the Philadelphia Electric Company has made use of the kenetron as the source of high-potential direct current. By means of it, declared Howard S. Phelps and E. Dean Tanzer, a large volume of data has been secured concerning the input current for a cable as a function of the time after complete electrification at a constant high potential. These data when plotted as curves show by their shape the condition of the cable insulation.

Curves showing a sharp decrease in the magnitude of input current during the first minute and a gradual but persistent rate of decay for the succeeding six or seven minutes indicate that the insulation is in an acceptable condition from the operating point of view. However, if the curves show little if any decrease or a persistent tendency to increase during the time interval of the test, it is an indication that the insulation has deteriorated to such a point that the cable may be expected to fail at an early date if retained in service. The degree of deterioration is indicated, first by the time which has elapsed in complete electrification before the increase occurs and, second, by the sharpness of the upward trend of the curve in any instance.

The value of this method of testing has been demonstrated by its actually having detected a considerable number of impending cable faults before they became a menace in operation. Additional refinements in the methods of measuring the input current for different classes of cables may be desirable. Further investigations are being carried on to determine the necessity.



PHASE "A" HAS AN INCREASED CURRENT AND CABLE FAILED IN ELEVEN DAYS. WHEN REPAIRED AND RESTORED TO SERVICE THE CURRENT SHOWED CHARACTERISTICS SIMILAR TO THOSE OF FEB. 25

Investigations of certain theoretical features are also being conducted, among them being oscillographic studies of the input current and voltage under test conditions.

Considerable interest was shown in the routine method of detecting impending cable faults as presented by Messrs. Phelps and Tanzer. J. L. Hayden pointed out that the method is particularly advantageous because it permits detecting gradual deterioration of the cable without subjecting it to extreme high-voltage tests and besides affords an opportunity for studying the internal action of the dielectric. However, he pointed out that the alternating-current tests have the advantage that they also indicate the dielectric loss.

D. W. Roper declared that this method has been applied in Chicago to the study of high-efficiency underground cable with low dielectric loss, but the studies have not been conducted long enough to reach any definite conclusions as yet. He brought out the interesting point that the initial current was about 150 times the final input current, indicating the need of more sensitive current measurement after the first few minutes if any upward trends in the curve are to be detected.

To show the reason for the change in the flow of current transient observed by this routine method of testing, Dr. C. P. Steinmetz gave a very interesting explanation of the phenomena which occurred in the dielectric. This explanation sustained Maxwell's theory

of dielectric absorption. In the perfect dielectric there is no slow transient, Dr. Steinmetz pointed out. In a non-homogeneous dielectric, however, the voltage gradient is distributed first inversely proportional to the specific capacities of the built-up insulation. Since the current is proportional to the voltage gradient, the dielectric resistivity and specific capacity, the current capacity cannot be the same in the different dielectrics unless the resistivities bear the same relation to the specific capacities in each dielectric. Hence the current must flow and establish charges which redistribute the voltage gradient. The speaker said that this method should therefore enable the investigation of components of dielectrics.

Regarding the difference between initial and final input current brought out by this test method, Mr. Tanzer said, in closing the discussion, that it may be necessary to have more refined methods of reading current on the more modern cables. He asserted that the inversion of the curve is the important factor, and not the difference between the initial and final currents. With refinements it may be possible to adapt this method to the testing of armature coils.

Joint Session with Chicago on Wednesday Evening

The technical aspect of the loud-speaking telephone and the problem involved in attaching the loud speaker to long-distance telephone circuits were discussed in a joint session with Chicago Wednesday evening by means of two-way long-distance telephony with the aid of loud-speaking instruments. All the papers and discussions were broadcasted. In the first paper, by I. W. Green of the American Telephone & Telegraph Company and J. P. Maxfield of the Western Electric Company, Mr. Green presented the problem encountered in the development of electrical systems for amplifying the voices of public speakers and music and described the equipment as brought to a commercial state and now in use in the United States and various other countries. The system employs four units—a "pick-up" mechanism or transmitter unit, a preliminary amplifier, commonly called the speech input equipment, a second or power amplifier, and a receiver-projector unit for transforming the amplifier current back into sound and properly distributing it throughout the space to be covered.

In the second paper, by W. H. Martin and A. B. Clark, both of the department of development and research of the American Telephone & Telegraph Company, Mr. Martin, speaking at Chicago, presented the various applications of the public-address system with telephone lines, stating the requirements for the lines, the circuit arrangement used and the more important operating features. He also gave a detailed description of the system used on Armistice Day, 1921, when large audiences at Arlington, New York and San Francisco joined in the ceremonies attending the burial of the unknown soldier at the National Cemetery at Arlington, Va. The main requirements for using loud-speaking equipment on this type of work are that the apparatus shall transmit a sufficiently broad frequency range and that short pulses within this range be transmitted without introducing oscillations of their own. This is best accomplished by using non-loaded open-wire lines or extra-light-loaded cable circuits.

Both papers were discussed simultaneously before the Chicago and New York audiences by J. J. Carty, vice-president of the American Telephone & Telegraph Company; B. E. Sunny, chairman of the board of directors of the Illinois Bell Telephone Company, and E. B. Craft, chief engineer of the Western Electric Company. Mr. Craft pointed out that telephone development was one of the master elements in research and in the progress of humanity—an opinion strongly indorsed by Mr. Carty. Mr. Sunny, in Chicago, said that the A. I. E. E. is now reaping the benefits derived from the movements which it has so amply backed and spoke of the Edison medal as a help to development and effort.

OBSERVATIONS ON ELECTRIC RAILWAY PRACTICE IN EUROPE

European practice regarding the type and character of rolling stock as compared with that used in America, the use of electric drive or locomotive, and the voltage used in the electrification of lines, was ably discussed by W. B. Potter of the General Electric Company, who has recently returned from an extensive trip in Europe. An interesting feature of European locomotives, he said, is the efficient condition in which they are kept. This is because the engineer operating the locomotive considers it as almost his personal property.

The compilation given here affords an idea of the extent of railway electrification throughout the world.

STEAM RAILWAY ELECTRIFICATION THROUGHOUT THE WORLD

	Route, Miles	Number of Electric Locomotives		Route, Miles	Number of Electric Locomotives
United States	1,607	375	Spain	48	17
Switzerland	661	156	Canada	49	9
France	602	338	Japan	39	42
Italy	650	309	Norway	39	37
Germany	550	49	Mexico	30	10
Sweden	237	44	Brazil	26	16
Cuba	180	18	China	25	13
Austria	340	42	Java	25	5
Africa	174	77			
Chile	154	42	Total	5,565	1,611
England	129	12			

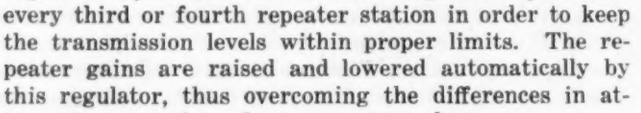
This table includes the steam railways which have been electrified or are in prospect of electrification, but not the steam railways on which multiple-unit trains are being operated exclusively or railways which were not formerly operated by steam. The mileage is less than 1 per cent of the railway mileage of the world. To bring about future electrification, Mr. Potter said, many engineering and economic problems must be solved and their solution demands the co-operation of all engaged in the furtherance of railway transportation.

Telephone Subjects in One Parallel Session on Thursday

Special methods are required to maintain the necessary stability of telephone transmission when small-gage cable circuits are used to handle long-distance service over distances up to and exceeding a thousand miles, according to the paper by A. B. Clark on "Telephone Transmission Over Long Cable Circuits." Several factors involved in the transmission of voice currents over long toll cable circuits must be considered. Among these are "echo" effects, transient impulse and attenuations and corresponding amplifications. To eliminate "echo" effects any unbalance in the system must be very small and the loading of long lines must be made at points further apart than with shorter lines. Changes in attenuation caused by the effects of varying

temperatures on the resistance of the conductors may be regulated by means of automatic regulators placed at every third or fourth repeater station in order to keep the transmission levels within proper limits. The repeater gains are raised and lowered automatically by this regulator, thus overcoming the differences in attenuation caused by the temperature changes.

In discussing this paper, J. J. Pilliod emphasized the point that space must be conserved by using cables for telephone work. Illustrating this, he compared the space requirements for a 300-circuit telephone system. If these lines were placed overhead, it would require



TRANSIENT IN NO. 19 EXTRA-LIGHT-LOADED LONG DISTANCE TELEPHONE CABLE

69,000 lb. of copper per mile and ten pole lines. On the other hand, with a cable system only 15,000 lb. of copper per mile would be required, with no pole lines if placed underground and only one if placed on poles. He pointed out that with overhead construction the size of wire must be very much larger than that required for the actual telephonic transmission in order to meet weather conditions such as sleet storms, heavy winds, etc. With the cable systems all these conditions are eliminated.

THEORY OF ELECTRIC WAVE FILTERS BUILT UP OF COUPLED-CIRCUIT ELEMENTS

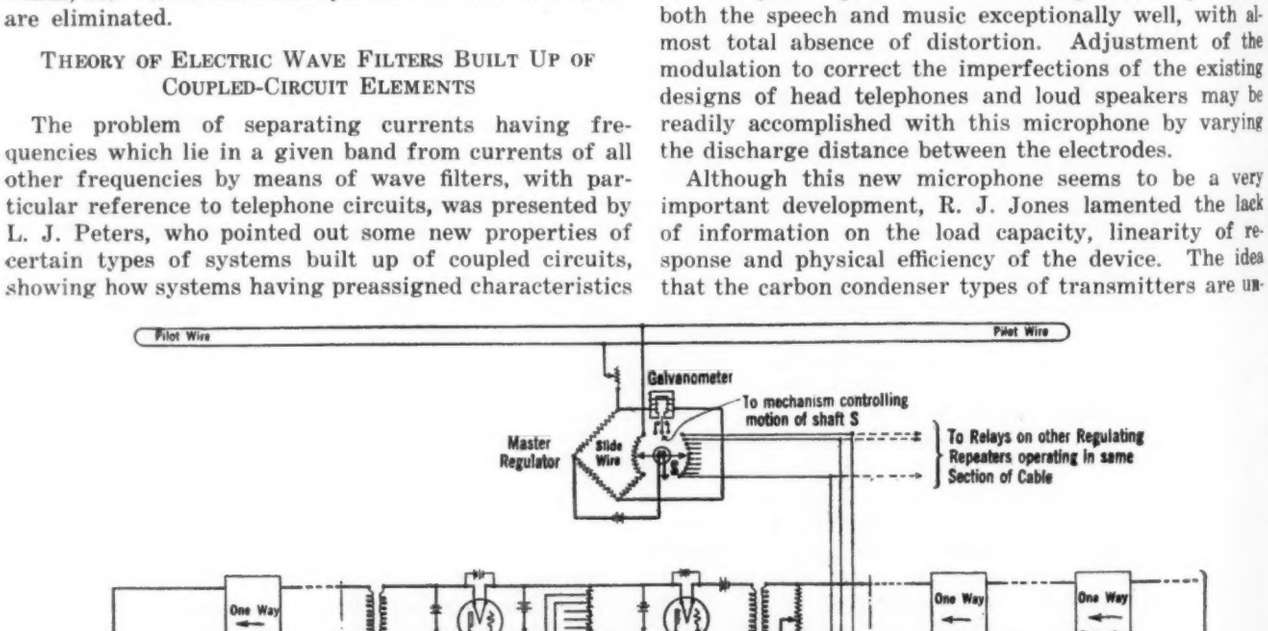
The problem of separating currents having frequencies which lie in a given band from currents of all other frequencies by means of wave filters, with particular reference to telephone circuits, was presented by L. J. Peters, who pointed out some new properties of certain types of systems built up of coupled circuits, showing how systems having preassigned characteristics may be built up in a rational way. Coupled circuit networks or filters are handled in a manner similar to those used in determining the properties of long lines with distributed constants. This method of treatment leads directly to the rational design of an electric system of a type which the older treatment of methods did not assume to exist. By proper termination and design sharp changes in the attenuation frequency characteristic can be employed to build up fiber networks of any type.

A DIAPHRAGMLESS MICROPHONE FOR RADIO BROADCASTING

A glow discharge microphone dispensing with the diaphragm ordinarily employed with the carbon or condenser type of transmitter was described by Phillips Thomas of the Westinghouse Electric & Manufacturing Company. In this microphone the application of a moderately high direct potential between two electrodes separated a short distance in air, with enough series resistance to prevent formation of the usual type of heavy-current arc, causes the establishment of a low-current, high-voltage discharge having a characteristic glowing appearance. The current consumed is from 1 milliampere to 20 milliamperes at voltages ranging from 200 or 300 to 1,000. Among the advantages claimed are simplicity, durability, low impedance and high sensitivity in addition to elimination of the diaphragm.

A demonstration of the microphone was given, an operator in one of the rooms of the building speaking into the device and also playing various kinds of music. A loud speaker placed in the meeting room reproduced both the speech and music exceptionally well, with almost total absence of distortion. Adjustment of the modulation to correct the imperfections of the existing designs of head telephones and loud speakers may be readily accomplished with this microphone by varying the discharge distance between the electrodes.

Although this new microphone seems to be a very important development, R. J. Jones lamented the lack of information on the load capacity, linearity of response and physical efficiency of the device. The idea that the carbon condenser types of transmitters are un-



PILOT WIRE AUTOMATIC TRANSMISSION REGULATOR

suitable for radio broadcasting and telephone work was thought to be unjustifiable, as recent results vindicated these types, an instance being the very successful use of the carbon transmitter in the joint session of the Chicago A. I. E. E. with the New York session on Wednesday night. Mr. Jones said that there were three radio broadcasting stations using the condenser type, while about thirty were using the carbon type. In all, more than two hundred of the carbon type are in use in both telephone and radio work.

J. B. Taylor deplored the lack of uniformity in the names given to the various radio instruments.

In summing up his paper, Mr. Thomas said that actual operating data would shortly be available on the new microphone.

A General Session on Railways and Power Equipment Was Also Held Thursday Morning

The second parallel session on Thursday morning was devoted to a series of three papers on railways, two on machinery and one on lightning arresters.

E. J. Blake presented a paper on the automatic train-control problem, indicating that most of the train-control systems are electrical or magnetic in their principle and operation. The Interstate Commerce Commission has commented on the need for some effective check on the functioning of human and therefore fallible engineers and has finally ordered automatic control installation on a large mileage of important lines.

The primary function of automatic control is to stop the train before it enters upon unsafe territory, but the author said that no automatic apparatus should relieve the engineer of complete responsibility for the safe operation of the train. It should act as a continuous check on the proper exercise of that control, intervening to stop the trains automatically only after the engineer has had ample opportunity to act and has failed. The train control device should not increase the hazards of operation in any respect, and the automatic control should place no avoidable restriction on the traffic capacity of the road. An effective argument in favor of automatic roadside signals has been the fact that they "keep the trains moving" and increase the traffic capacity.

The simplest automatic control, one which is in use on urban subway and elevated lines, is an air valve hung on the car truck near the rail level and stop arms operating in conjunction with the fixed signals in such a way that if a stop signal is displayed the stop arm is raised into the path of the air-valve handle and actuates it, thus making an emergency operation of brakes. This system naturally does not meet the requirements just mentioned. Modifications of this simple system involve principally electrical or magnetic controls of the air valve, the operation of these controls depending upon current flowing or not flowing because of the presence of other trains within the danger area. All of these, however, fail to give the necessary caution signal to the engineer at present given by the "distant" block of the roadside signals, but rather operate to stop the train in case of actual danger.

Another system, the author continued, known as the "continuous induction" system, is arranged to supply the indicating energy for the locomotive to the rails of the track circuit in the form of alternating current which is collected inductively on the locomotive. If the track ahead is clear, the detecting apparatus is continuously energized, but if occupied, or if the indicating current supply fails, the locomotive apparatus becomes de-energized and a brake application results.

The problem at the present time is to modify operating rules slightly to fit the limitations of the existing automatic systems, or more fundamentally to develop the automatic control systems in some way so that they will give adequate advance notice to the engineer but will ultimately operate to stop the train in case of human failure in the cab. "Thus," concluded Mr. Blake, "with automatic control in force, it seems likely that the future trend of signal development will be toward cab signals rather than roadside signals—first, because they are inherently capable of giving greater protection, and, second, because they involve less apparatus over and above that required in any case for the automatic control."

Frank J. Sprague declared that the most important tests of train control are now being conducted by the New York Central Railroad. The general requirements of train control were tersely summarized by the speaker, who declared that it must protect but not hinder train operation. Furthermore, apparatus used in train control should not function except when needed, if excessive maintenance cost is to be avoided. About four thousand different schemes have been submitted to the railroads, Mr. Sprague said.

Automatic Substations and Single-Phase Regeneration Discussed

A discussion of the application and economics of automatic railway substations was the next paper, presented by L. D. Bale of the Cleveland Railway Company. This was the same paper which he presented at the Cleveland Section of the A. I. E. E. last April. Mr. Bale emphasized the economies from the standpoint of distribution efficiency resulting from a reduction in distribution copper on account of establishing a larger number of substation operating points. He dwelt also on the economy of operation without manual operation. He paid tribute to the effectiveness and reliability of the automatic operating equipment, but pointed to the fact that each and every application of this equipment will present a variation of control features by reason of new or different operating conditions. While his experience had been principally with railways, he said that the system was applicable also to Edison direct-current substations, to small hydraulic plants and various other kinds of installations.

L. J. Hibbard presented a paper on systems of single-phase regeneration for use with series-type commutator motors. Mr. Hibbard's paper was essentially a record of accomplishment in advancing the art of regeneration by single-phase motors. Single-phase regeneration is, of course, not new, but it is less advanced in its development than direct-current regeneration. Mr. Hibbard classified the various schemes of regenerative connection for single-phase motors as follows: (1) Series excitation; (2) self-excitation or cross-excitation; (3) shunt excitation; (4) separate excitation. The third and fourth classes have been commercially applied, but, according to Mr. Hibbard, no commercial applications of the first and second have been made as yet.

Mr. Hibbard then gave connections and diagrams for the various classes and discussed a particular method

devised by himself by which he is able to control the degree of regeneration and the power factor at which this regeneration occurs, the second point being the most striking in connection with the problem of single-phase regeneration. In his analysis of this method he developed a vector mechanism by which the various values and the phase relations of voltages, currents and fluxes could be shown graphically by different settings under the control of the operator.

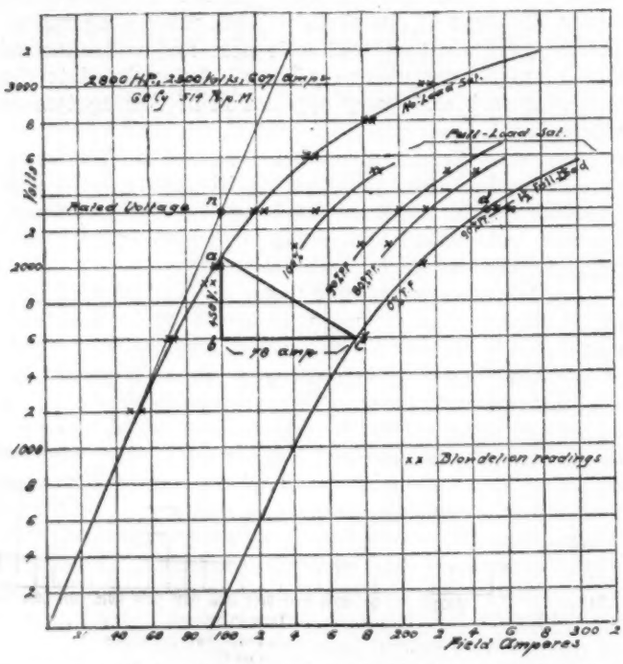
The chief comment on Mr. Hibbard's paper was to the effect that it did not cover commutation. Attention was called to the fact that both alternating-current and direct-current components must be commutated in a machine of the type considered during regeneration. One single way to reduce the alternating-current component is to reduce the flux. This can be done by connecting a reactor around the commutating poles. Shunt excitation is simpler than separate excitation but produces lower power factor, the speaker contended.

A New Kinematic Device

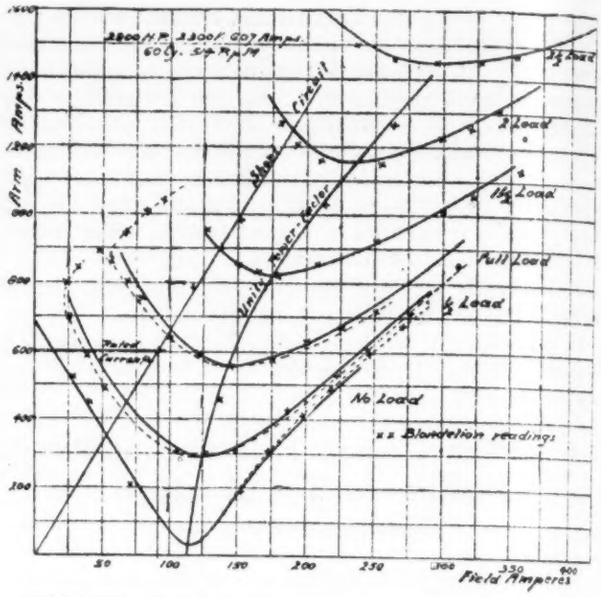
"The Blondelion" was the title of a paper presented by Prof. Vladimir Karapetoff. The "blondelion" is a kinematic device which enables one to compute the performance of a polyphase synchronous generator or motor. It is fundamentally a combination of movable and adjustable bars, linkages and straight and curved guides, and its purpose is to enable a designer to select the best electrical constants and a no-load saturation curve and to "test" a synchronous generator or motor before it has been actually built. There are also other auxiliary uses, such as to take the place of involved analytical and theoretical investigations and to replace circular diagrams, etc.

This "blondelion" is one of several kinematic devices developed by Professor Karapetoff, the others being the "secomor," the "indumor" and the "heavisidion," while still others are under preparation. The first two have already been described before the Institute and the third was described this year.

Professor Karapetoff explained his "blondelion" by



NO LOAD AND LOAD SATURATION CURVES ON A GENERATOR CHECKED BY THE BLONDELION BY CROSSES



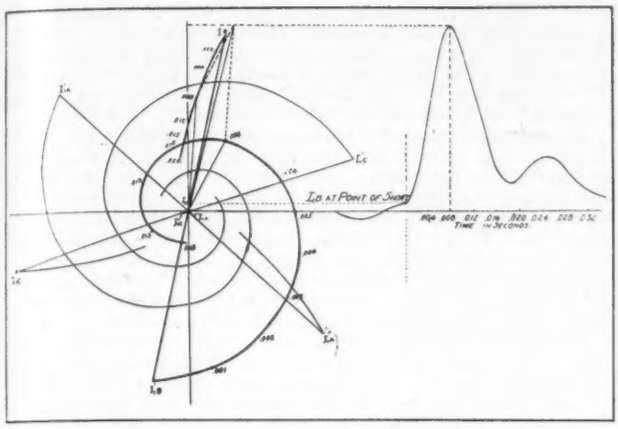
SHORT-CIRCUIT AND V CURVES ON A SYNCHRONOUS MOTOR CHECKED BY THE BLONDELION

an analogy. First he pointed out that it is fundamentally the linking up of four vectorial equations, represented by mechanical linkages, so that when one degree of freedom of motion of the device is allowable, then with any given set of conditions the desired answer may be found. His simple mechanical analogy he explained as follows: It would be possible to set up a scale of lengths of cylindrical tanks and a scale of diameters of cylindrical tanks and a scale of corresponding surface areas of tanks and devise a mechanism, pantographlike, which would, when one point is set at a given length and another has a given diameter, bring the third point to rest at the area of the particular tank; but obviously, if the point were set on a given area, there would be an infinite number of combinations of lengths and diameters to produce that area. Similarly, a scale of tank volumes might be set up to work in relation to the length and diameter scales the same way as the area scale, but again for any given volume there would be an infinite combination of lengths and diameters. However, if a combination mechanism to operate on all four scales were devised and one point were set at a given area and another point were set at a given volume, the other two pointers would together come to rest at one point of each scale, thus giving a definite length and a definite diameter.

Carrying this fundamental principle into the complex synchronous machinery field, Professor Karapetoff devised his "blondelion" to take into account all the variables of the characteristics of the machinery, and in such a way that it could give answers as to all the operating characteristics which one needs or would wish to know about the machine.

The accompanying figures show two sets of curves taken by test from a certain machine and also indicate various points on these curves as calculated by the "blondelion." These show the accuracy of the device.

Prof. W. V. Lyon presented a paper on "Transient Conditions in Electrical Machinery." This paper was essentially mathematical, Professor Lyon having reduced to simple mathematical form various equations of electrical machinery transients. He did this by the introduction of complex angles and complex angular



$R_1 = 0.0172$ $R_2 = 0.0455$
$L_1 = 0.00569$ $L_2 = 0.00996$

$\tau = 0.0483$

Taking into consideration the effective resistance
$m'_1 = 96 + j360$ $m''_1 = 60.4 + j17.5$

$I_{1B} = 90.5 \sin 85°$

$i'_{1B} = I'_{1B} \frac{-96t}{e} \sin (360t + 258°)$

$i''_{1B} = I''_{1B} \frac{-60.4t}{e} \sin (17.5t + 78.3°)$

FIG. 1—VECTOR DIAGRAM UPON WHICH NO LOAD ANALYSIS WAS BASED

velocities added to the complex vector representation hitherto employed. The paper, therefore, presented no particularly new theory with reference to the transients in machinery, but rather a new method of attack on the problem of their calculation.

Prof. A. E. Kennelly, in the absence of Professor Lyon, presented the paper, commending it as showing a method which was practical in its application. J. O'R. Coleman, a research associate of Professor Lyon, showed the results of tests which he had performed under the direction of the latter to check experimentally a part of the theory presented. The tests were performed on a General Electric 75-hp., three-phase, 900-r.p.m., 220-volt induction motor operated as a generator.

Mr. Coleman presented three slides. Fig. 1 gives the vector diagram upon which the analysis is based for the short circuit at no load. The vectors I_{1B}, I_{1C}, and I_{1A} represent the current in the three phases just before short circuit, assuming that a short circuit begins just before I_{1B} is at a maximum, the vectors being in the position shown. At this moment I_{1B}, for example, breaks up into two components, I'_{1B} and I''_{1B}. After the short circuit occurs the terminus of the vector I'_{1B} travels along the logarithmic spiral shown at the velocity of 360 circular radians per second and is damped at the rate of 96 hyperbolic radians per second, all based on 60-cycle operation. I''_{1B} travels along its spiral as shown with a velocity of 17 circular radians and a damping rate of 60 hyperbolic radians per second. At any specific time the positions of I'_{1B} and I''_{1B} and their instantaneous lengths may be found, and their vector sum projected on the time axis gives the instantaneous value of current in phase B at that moment. Similarly the current at any other moment in any phase may be found.

An oscillogram was taken of the short circuit (see Fig. 2). It will be noted that the short circuit in phase C came for some reason just a little after that in phase A and B, and the calculation was based on a compromise time just before phase C was short-circuited. Fig. 3 shows the actual oscillogram compared with the calculated values as obtained from the vector diagram described. For phases A and B the agreement is very satisfactory, but for phase C there is a slight disagreement, doubtless due to the time lag of the actual short circuit in that phase.

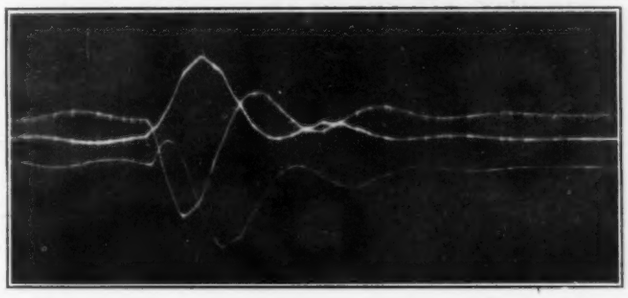
Thus, Mr. Coleman pointed out, the experimental results indicate that the calculated results are sufficiently close to be of practical use.

A desire to have the transients in transmission and distribution systems studied in a similar manner to that used with rotating machinery was expressed by D. W. Roper, who offered the system of the Commonwealth Edison Company for checking any theoretical or laboratory conclusions.

Prof. V. Karapetoff expressed the belief that Professor Lyon's method could be applied more extensively, but warned scientific men against working for approximate results. Accuracy should be the aim, he declared. For example, he referred to the mutual induction of primary and secondary coils in rotating machines, saying that it depends upon their relative position and hence is a function of time, T.

A paper by A. L. Atherton, entitled "1922 Developments in Auto-Valve Lightning Arresters," closed the session. Mr. Atherton said that his paper was primarily an outline of auto-valve lightning-arrester development, an outline of the progress of which was presented at the midwinter convention of 1922. In the issue of the ELECTRICAL WORLD for last week, page 385, an article by Mr. Atherton appears on the performance characteristics of these auto-valve lightning arresters. His convention paper was fundamentally a discussion of the theory involved in the development of the arrester and a record of the tests which had been made to determine some of their technical characteristics.

The auto-valve arrester received several commendations, but some questions were raised by E. E. F. Creighton as to how a glow discharge (on which the



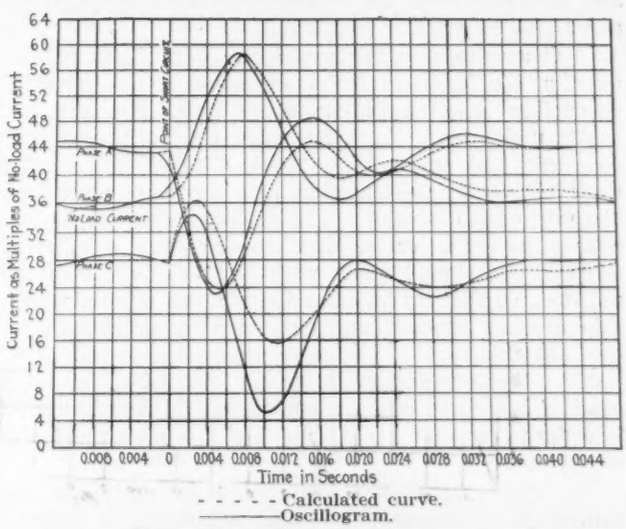


FIG. 2 (ABOVE)—SHOWS AN OSCILLOGRAM OF A SHORT CIRCUIT AND FIG. 3 SHOWS THE ACTUAL OSCILLOGRAM COMPARED TO THE CALCULATED CURVE

action depends) can be maintained at the current densities which occur; also, how the detonation accompanying a discharge at three times voltage can be withstood with the construction employed. Dr. C. P. Steinmetz commented chiefly on the advantages of using a large-capacity direct-current high potential to simulate lightning discharges and thus test arresters under conditions comparable with actual service. The time is rapidly approaching, he declared, when arresters can be tested for performance as accurately as rotating machinery. Attention was, however, called to certain obstacles that must be overcome first.

D. W. Roper reported that several of the auto-valve arresters had been subjected to service tests on the Chicago system in comparison with other types. Very favorable results were obtained with the new type, and more units are being placed on the system. The only auto-valve arresters that did fail protected their apparatus and then were damaged by the highest voltages recorded on the system.

In closing, Mr. Atherton emphasized that virtually the only failures of the auto-valve arrester have been due to flashover destroying the insulating enclosure. He also pointed out that this arrester is a high-speed device and shows no signs of internal impairment after discharging heavy currents successfully. No power current follows the discharge, indicating that the glow discharge, upon which the action depends, is maintained.

Commenting on the breakdown of the gaps involved in the auto-valve arrester, Dr. Slepian contended that until a gap becomes less than one wave length of light it cannot break down at less than 350 volts. Between plain electrodes the breakdown voltage is a direct function of the amount of gas between electrodes.

Thursday Afternoon Devoted to Machine Switching and Radio

On Thursday afternoon a large audience listened to the presentation and discussion of three notable papers on communication. A paper on "Machine Switching Telephone Systems for Large Metropolitan Areas," by E. B. Craft, L. F. Morehouse and H. P. Charlesworth, was presented by Mr. Morehouse. This paper gave the historical development of communication methods, described the present A and B board manual operation, and then discussed the metropolitan application of the panel type of machine switching.

In discussing machine switching the authors pointed out that the functions to be performed by the telephone subscriber in getting a connection must be simple and easily understood. It must work efficiently and with accuracy and speed. The system must not require modifications in the existing rate structure which are otherwise not desirable. The system should employ, as nearly as practicable, the conventional numbering scheme. It should work with the existing telephone network, so that its introduction will not require wholesale number changes and extensive rearrangement or the abandonment of existing switchboards or other plant. Its introduction must, of necessity, be on a gradual basis and must be sufficiently flexible in design in order to care for growth and also for changing traffic conditions.

The authors then followed with a description of the routine of the machine-switching operation, as follows:

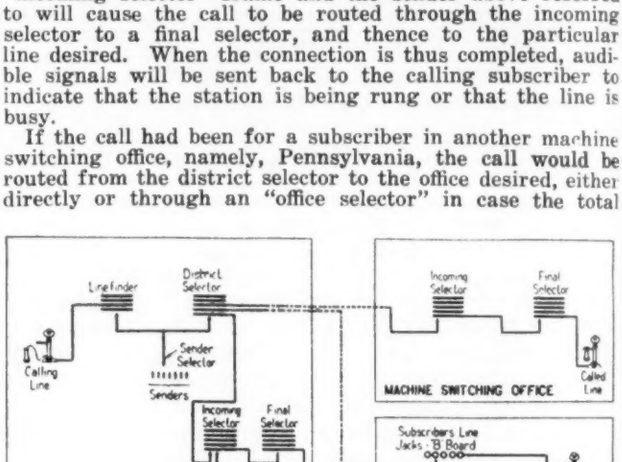
The progress of a call originating in a machine switching office is briefly as follows:

The line of the calling subscriber, who is assumed to be a subscriber in the Academy office, appears in a so-called "line finder" frame. When the subscriber's receiver is removed from the switchhook preparatory to dialing, the line is selected by a "line finder" and connected to an idle "sender" by means of a "sender-selector."

Upon completion of these operations, which take but a fraction of a second, the dial tone is sent out to the calling subscriber as previously mentioned. When the subscriber dials, electrical impulses on a decimal basis are transmitted to the sender, which receives and registers them, translating them in turn to the proper basis for the control of the selectors which are not operated on a decimal basis. The sender automatically causes the particular "district selector" which is permanently associated with the line finder originally used to select a trunk to the office desired.

Assuming that the call is for a subscriber in the same office, Academy, the trunk chosen will terminate at an "incoming selector" frame and the sender above referred to will cause the call to be routed through the incoming selector to a final selector, and thence to the particular line desired. When the connection is thus completed, audible signals will be sent back to the calling subscriber to indicate that the station is being rung or that the line is busy.

If the call had been for a subscriber in another machine switching office, namely, Pennsylvania, the call would be routed from the district selector to the office desired, either directly or through an "office selector" in case the total



SCHEMATIC DIAGRAM OF THE CONNECTIONS AND EQUIPMENT NECESSARY IN MACHINE SWITCHING

number of trunks to all offices is too large to be placed on the district-selector multiple. These trunks terminate on incoming selectors at the Pennsylvania office, which select the subscriber's line through final selectors, as described above.

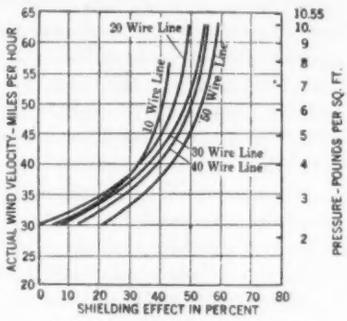
If the call is for a subscriber connected to, say, the Worth office, which is a manual office, the call would be routed from a district selector directly or through an office selector to the "B" board in the Worth office, where the number desired would appear in front of the operator at a "call indicator position" in the form of visible numbers on the keyshelf. The operator is advised of the trunk to which the call is connected by suitable signals, and the call is completed by plugging this trunk into the desired subscriber's line.

Calls originating in a manual office and intended for a machine switching office reach the machine switching office over trunks from the "A" operators in the manual office. At the machine switching end these trunks terminate in incoming selectors, which have access to the final selectors on which the subscriber's lines are located. The selectors are under the control of a special group of senders, and operators are provided with suitable keys for setting up in these senders the number of the desired subscriber. These operators at the machine switching office receive the information as to the desired number from "A" operators in the distant manual office, exactly as is done in the case of manual operation.

The paper then took up the detail apparatus and its functioning in bringing about the desired operation. Several prominent telephone engineers discussed this paper and elaborated on the engineering and development work required to produce the system, pointing out

the effect of the adoption of the machine-switching practice.

In a paper entitled "Wind Shielding Between Conductors of Telegraph and Telephone Lines," F. J. Howe gave a description of some very valuable tests made to evaluate the effect of wind on conductors. The experimental work may be summarized as to results by the conclusions of the paper:


20 Wire Line
10 Wire Line
60 Wire Line
30 Wire Line
40 Wire Line
ACTUAL WIND VELOCITY - MILES PER HOUR
PRESSURE - POUNDS PER SQ. FT.
SHIELDING EFFECT IN PER CENT
VARIATION IN SHIELDING WITH WIND VELOCITY

1. The formula $P = 0.0025\ V^2$, in which P is the pressure in pounds per square foot of projected area on cylindrical surfaces, and V is the wind velocity in miles per hour, may be used in calculating wind pressures on *unshielded* ice-covered conductors.

2. A definite shielding effect exists between ice-covered telegraph and telephone conductors carried on the same cross-arm and closely spaced (about 12 in. center to center) as in modern telegraph and telephone practice.

3. A similar shielding effect also exists between such wires carried on different cross-arms spaced 2 ft. apart.

4. The amount of shielding on any number of wires increases with the wind velocity and vice versa.

5. The shielding at any wind velocity varies with the number of wires, increasing as the number of wires increases and vice versa.

6. On telegraph and telephone lines having conductors coated with ice ½ in. in radial thickness the total shielding effect at wind velocities corresponding to a pressure of 8 lb. per square foot, even allowing a 10 per cent reduction from the test results in order to compensate for possible inaccuracies, will run from a minimum of 39 per cent on a ten-wire line to as high as 51 per cent on a fifty-wire line.

In the discussion which followed Mr. Howe's paper there was general agreement that a valuable contribution had been made to a subject which had never permitted exact conclusions; yet it was pointed out that the allowances now used for wind shielding effects were on the safe side.

The last paper of the session was entitled "The Wave Antenna" and was by H. H. Beverage, C. W. Rice and E. W. Kellogg. It was presented by Mr. Kellogg. The paper was an elaborate theoretical treatise and afforded opportunity for a splendid treatment of a highly specialized subject.

The wave antenna is a new type of highly directive antenna used by the Radio Corporation on Long Island. It consists of two copper wires, 9 miles long, strung on poles, and it is said to receive transatlantic messages. This type of antenna is considered a marked advance in that it reduces interference and "static" and also is aperiodic and a good energy collector. A mathematical analysis of the performance of the antenna was given, with a description of accessory details.

The theoretical problems and practical accomplishments were dealt with by the authors in connection with the Riverhead antenna of the Radio Corporation and curves and oscillograms were used to bring out the phenomena associated with the action of the antenna.

By a process of balancing, it is possible to produce a "blind spot" or direction of zero reception, at any angle more than 90 deg. from the signal. One method of obtaining this result is by producing reflections of certain phase and intensity at the end opposite to the receiver. Reflections at the receiver end of the antenna, on the other hand, do not alter the directive properties of the antenna.

Electrophysics Session on Friday Morning Has a Warm Discussion on Fundamentals

On Friday morning a group of five papers was presented under the auspices of the electrophysics committee. In the paper on "Dissymmetrical Electrical Networks" written and presented by Dr. A. E. Kennelly it was pointed out that the solution of complicated networks when symmetrical could very readily be obtained by replacing the network with equivalent T or Π lines. When the network is dissymmetrical the system can be replaced by two symmetrical systems and a terminal load, by two symmetrical leak systems and a leak load or by a new development of the author in which the solution is obtained by using angles, the geometrical mean surge impedance and the inequality ratio.

Prof. F. S. Dellenbaugh, Jr., in discussing the paper, pointed out that the methods indicated by Dr. Kennelly had a wide practical application. He cited an instance in which an engineer had taken a day to solve a network problem while a young student familiar with the method of Dr. Kennelly had solved the problem in half an hour. The system requires the use of hyperbolic angles, but is relatively simple as to mathematical operations and far quicker and more accurate than the method which involves the laborious application of the generalized Ohm's law.

The "Physical Interpretation of Complex Angles and Their Functions" was the topic of a paper by A. Boyajian. In this paper the author reduced to simple terms, meanings and usages many of the so-called complicated terms now used in angular calculations. He treated angles as percentages and pointed out that, for example, a 1 per cent line drop in phase with the voltage really was 1 per cent of a hyperbolic radian, which could be changed to degrees by multiplying by 57.7—i.e., 5.77 deg. In a similar manner a quadrature drop—for example, 1 per cent—is really 1 per cent of a circular radian, which could be expressed in degrees in a similar manner—i.e., 5.77 deg.

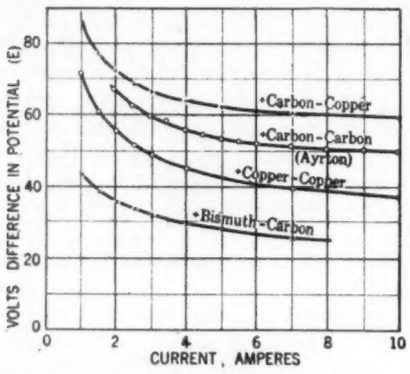
Prof. V. Karapetoff stated that Mr. Boyajian had made a valuable contribution to the literature by so clearly and lucidly interpreting mathematics of a complicated character. Dr. Kennelly also complimented the author, but pointed out that when dealing with hyperbolic angles rotation must be considered.

A notable paper entitled "Radiation from Transmission Lines," by Charles Manneback, was presented by Prof. F. S. Dellenbaugh, Jr. This paper dealt with the loss of energy due to radiation in low-frequency transmission lines and, taking exception to the opinion of Dr. Steinmetz, proved that radiation was negligible.

The problem, the author showed, involves a study of what might be called time-three-dimensional space transient, while the most complicated transients considered in electrical engineering are time-one-dimensional space transients. The distribution of current along the conductors of a line was shown to be a very close approximation to the actual, unknown distribution with regard to the possibly existing radiation. Then, from this assumption, the radiation of the system was calculated at a corresponding approximation and its amount found to be negligible compared with the heat dissipated in the line during the same time. From this it was concluded that the effect of the radiation

upon the attenuation and the distortion of the waves along the line must also be negligible, compared with the effect of the joulean losses.

An application to the steady radiation from a transmission line oscillating freely at one of its natural frequencies showed, even at very high frequencies, that the power radiated was negligible compared to the heat dissipated. For instance, a 100-kw. transmission line, No. 00 B. & S. wire, oscillating at 3,000,000 cycles per second, wastes by radiation only one-thirty-six-hundredth part of what is wasted by heat. The influence of this radiation on the attenuation and distortion of the traveling waves was thus found entirely negligible in engineering practice. Professor Karapetoff agreed with the author in his conclusions as did Dr. Slepian. Dr. Slepian pointed out that radiation occurred only when reflections were present and showed how Newton's law applied. Even with reflection present, the effect of radiation is negligible, he observed.



VOLT-AMPERE CHARACTERISTICS WITH THE ARC LENGTH CONSTANT

A paper entitled "A New Equation for the Static Characteristic of the Normal Electric Arc," by W. B. Nottingham, discussed the arc formed between any electrode materials and for any length of arc. The author found that if the length of the arc is constant, the equations of Aryton and Steinmetz can be written as

$$E = A + B/i^n,$$

in which A and B are constants dependent on the arc length and electrode material, while the exponent n depends only on the electrode material and is found to be directly proportional to the absolute temperature of the boiling point of the anode material.

Using this equation as a basis, the author then studied the effect of arc length and developed a three-term equation for arc characteristics which checked well with many experimental observations. The author was highly complimented by several members on his contribution to research.

A paper that brought out spirited discussion was written and presented by Dr. Carl Hering under the title "Electromagnetic Forces: A Search for More Rational Fundamentals; A Proposed Revision of the Laws." The paper was premised on several experiments allied to the pinch and stretch effects and contained conclusions by the author that existing conceptions of electromagnetism were erroneous or at least subject to question. The author also presented a new generalized law based on the proposition that "in any system such motions will tend to take place as will reduce the potential energy of the system." The experiments were qualitative and the deductions of the author were to the effect that longitudinal forces due to magnetic fields were present. The author explained the force actions by use of the production of a counter-emf. and a connection between the flux and the conductor.

C. O. Mailloux opened the discussion with an attack on the Maxwellian system of mathematics and supported Dr. Hering's contention that investigation was needed. He indicated the possibilities of an investigation of the theory that magnetism was elastic in physical behavior and gave a fine résumé of the evidence and opinions which exist for present theories.

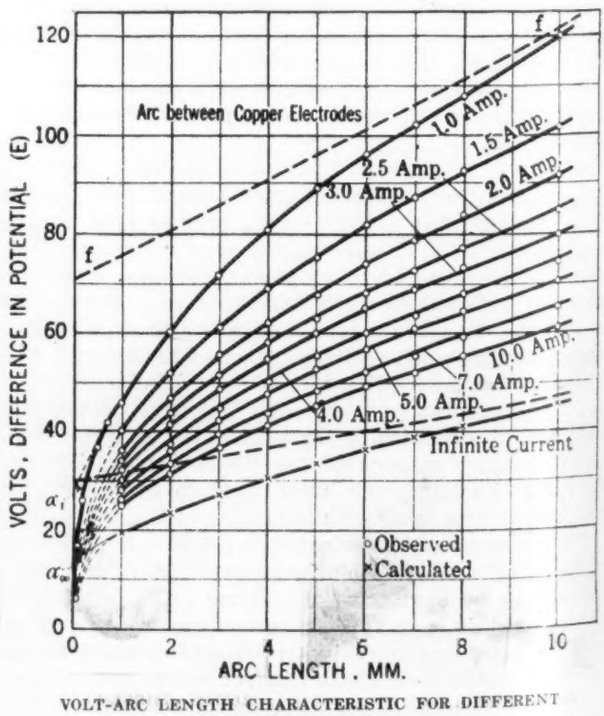
Professor Karapetoff pointed out just what Maxwellian and Kelvin mathematics represented and stated that the mathematics was a separate entity from the physical nature of electricity and magnetism. The latter is largely still theoretical, while the former gives quantitative and accurate results for all cases known in the paper. He indicated his belief that each of the experiments could be explained on the basis of complete and partial linkage changes and stated that the coefficient of self-induction was a quantitative criterion for determining the accuracy of the experiments.

Professor J. H. Morecroft agreed with Professor Karapetoff that the experiments were not conclusive because qualitative and said that they could all be explained by present laws. He indicated, as did Professor Karapetoff, an intention to carry out quantitative experiments of a similar character.

John Mills supported Dr. Hering in his contention that a revision of existing laws was necessary, but stated his belief that all the experiments could be explained on the basis of electronic effects and that flux and magnetism unnecessarily complicated the problem. Other discussion occurred without conclusive results, but the general opinion was expressed that the paper was stimulative to thought and valuable for its experiments.

Effect of Minor Hysteresis Loops Approximately Calculated

In his paper on "Permeability," Thomas Spooner discussed the application of mathematics and graphs to determine the effect of minor hysteresis loops on the behavior of iron used in telephone transmitters, radio



VOLT-ARC LENGTH CHARACTERISTIC FOR DIFFERENT CURRENT VALUES

transformers and similar devices in which alternating current and direct current are superimposed. His paper showed the resultant equations and methods for getting approximate quantitative results.

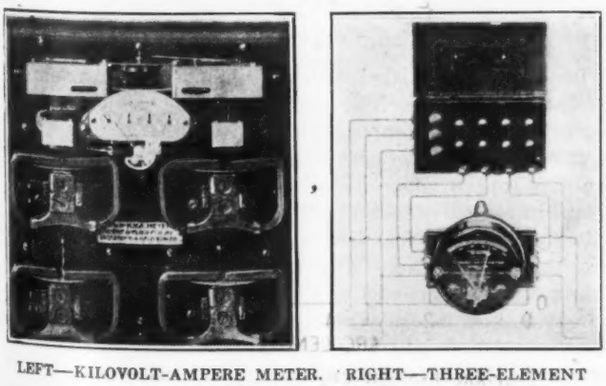
Metering and Meters Discussed Friday Afternoon

In a paper entitled "Applications and Limitations of Thermocouples for Measuring Temperatures," by I. B. Smith, which was presented by title, the author summarized the practical applications of the device and the errors that may occur in use. He pointed out that the thermocouple was now greatly used in the precision measurement of the temperature of feed water, flue gases, bearings, windings, cables, etc., and that in these many uses care must be taken to eliminate errors. He discussed ten sources of error that may occur and pointed out how to eliminate or anticipate their effects. He then discussed rules and methods for measuring temperatures and showed the necessity for standardization if comparable results are to be obtained.

The use of thermocouples for measuring temperatures in underground cable systems has been very successful, according to E. D. Tanzer of the transmission department of the Philadelphia Electric Company. He described one instance where thermocouples were used in a 400-ft. duct line at intervals of 50 ft., with all the leads brought back to one point for reading the temperature value. In this way very accurate indications of conditions met with in underground systems can be obtained. A unique use of thermocouples was cited where a break in an underground steam main was located by making temperature tests throughout the length of a duct line running near the steam main, the location of the broken portion being indicated within a few feet by the abnormal temperature shown by the indicator.

G. H. Cole, in speaking of the inaccuracies encountered in the use of thermocouples, said that the greatest cause of trouble was in the contact drop at the thermocouple itself. He advocated that the leads be attached to opposite sides of the active material instead of on the same side.

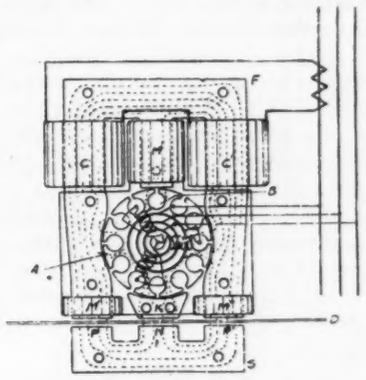
In a paper entitled "Volt-Ampere Meters," R. C. Fryer gave a résumé of meter developments and illustrated existing types as applied to metering kva. He tabulated the types as they involve different principles as shown in the accompanying table. Mr. Fryer then discussed each type and its application advantages and disadvantages and indicated a belief that the kilovolt-ampere meter will be on a plane with the kilowatt-hour meter in a few years.



LEFT—KILOVOLT-AMPERE METER. RIGHT—THREE-ELEMENT AMPERE-HOUR METER

P. A. Borden discussed the Lincoln-type meter, which is largely used in the system of the Hydro-Electric Power Commission in Canada, and said good results had been obtained.

In regard to a question as to actual meters on the market, Mr. Fryer stated that the meter manufacturers were prepared to give almost any kind of measuring instrument to the industry, but that the industry was as yet very undecided as to just what it wanted. This was brought about by the fact that so many different clauses relating to charges in billing for low power factor were in use. As stated in the original paper, of the 418 utilities in cities of 20,000 or over in the United States and Canada, fifty-nine companies have clauses considering power factor, and of these there are twenty different kinds.



ONE ELEMENT OF AN ANGUS THREE ELEMENT METER

The consensus of opinion seemed to be that accurate volt-ampere meters were very much needed and that developments in the past year on this type were very encouraging. Among those taking part in the discussion were Charles Fortescue and E. P. Peck.

TYPES AND MAKERS OF VOLT-AMPERE METERS

(1) Proper-phase-relation-type meters	Full range	Bodi (Westinghouse); Angus (Esterline-Angus)
	Fixed range	General Electric; Lincoln
(2) Resultant-type meters	Full range indicating	Lincoln; Sangamo
	Full range integrating	Sperti-Blecksmith; (Westinghouse)

A notable paper entitled "The Measurement of Power in Polyphase Circuits" was presented by Charles Fortescue. It showed the necessity for reconsidering the present commercial trend in power measurements. Although meters and rate systems account for power factor and demand elements, unbalance is not considered and an inequitable application of power-factor penalties occurs in many cases. He stated that unbalanced effects were of the same order of magnitude as reactive kva. effects in many cases and showed that the consumer often was charged for reactive power or unbalanced power consumption brought about by other consumers' apparatus. He then introduced the sequence idea of power measurement and proposed a new method.

The proposal made was that the positive phase-sequence power output only be measured and the power charges be made on the basis of this measurement. It was further proposed that the unbalanced kva., which is the product of the positive sequence voltage and the negative sequence current, be measured either by means of a negative sequence ammeter, indicating or recording, or a kva. meter, and a charge made for the amount of unbalance. The user of symmetrical polyphase rotating machinery should then pay a lower rate, based

on the estimated cost of unbalance, and the consumer having unbalanced loads should be charged directly for the amount of unbalance he creates, or else should have his positive phase-sequence power rate increased, based upon the estimated cost of unbalance. Devices for measuring these quantities are being developed, the author said, and the outfit for making these measurements will be no more complicated than the present existing measurement devices. In fact, the tendency is toward greater simplicity.

In presenting the subject the author had no intention of suggesting how rates should be made, but merely wished to point out what factors enter into the question of equitable rates when the polyphase system is subject to unbalance.

R. D. Evans discussed the paper and showed that metering devices could be made to measure sequence quantities. Standard instrument transformers and meters could be used, and in addition an auxiliary box containing the necessary network impedance. In his opinion, fewer meters would be required than with existing methods.

E. P. Peck said that any factors that cannot be readily understood by the power consumer cannot be used in billing a customer for the energy consumed. Consequently it is inadvisable to bring in a factor such as unbalance of load, particularly as this is not one of the main factors that affect the rates. Varying load factor, total load and the initial cost of equipment utilized in stations and the distribution systems are much more important. In his opinion, billing on a kva basis was one of the best methods, as this can be understood more readily by the general consumer.

Professor Karapetoff was also of the opinion that the rate basis must be easily understood. He explained a simple mechanical analysis that might simplify the problem of making the unbalanced condition understandable to the consumer.

A New Type of Oscillograph

A paper that brought out a great deal of discussion was entitled "Expansion of Oscillography by the Portable Instrument." The author, J. W. Legg, described a portable oscillograph of a new type. The three galvanometer magnets are of the permanent type, and the resistors and shunts are in the oscillograph box. An incandescent lamp with arrangements for getting abnormal voltage for the time of film exposure and

GENERAL ASSEMBLY OF COMPLETE INSTRUMENT

the use of 110 volts alternating current or a storage battery for motive power are other distinctive features of the instrument. The author showed the many fields of application and presented oscillograms of typical cases. J. R. Craighead discussed the paper and asked several questions of the author in regard to heat radiation and the voltage range of the resistors, the insurance of lamp brilliancy when photographing transients, total weight of box, etc. He also said he had used the older type of oscillograph for many types of field

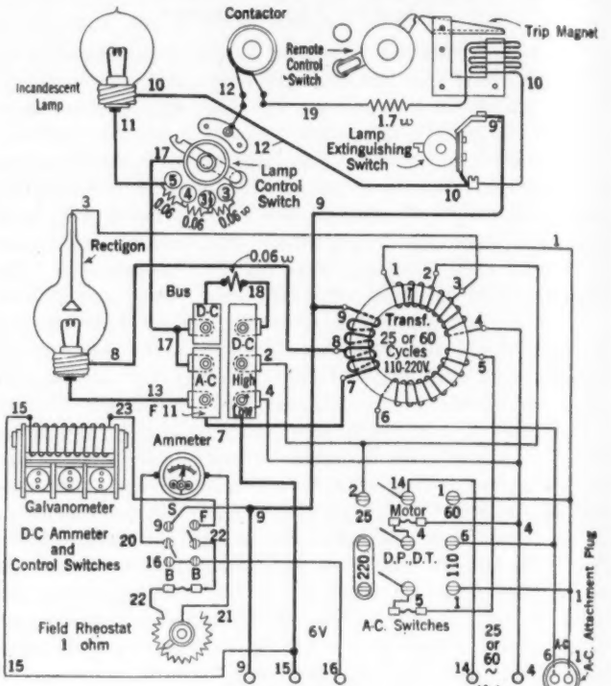


DIAGRAM FOR SUPPLY CIRCUIT FOR MOTOR, LAMP, ETC., IN OSCILLOGRAPH

applications. P. A. Borden gave examples of using oscillographs in logging camps, isolated power plants, under tents, etc., and said they were great assets to an operating engineer.

The use of tungsten wire in air as an element for producing the intense light necessary for the mirror and film was suggested by H. L. Curtis. The use of aluminum mirrors instead of silvered glass was also suggested. The great advantage of this would be that electromagnetic damping of the elements could be accomplished, thus doing away with the present use of oil for this purpose. A method of keeping silvered mirrors was suggested by E. D. Doyle. He had had very successful results in placing the elements in a glass bottle instead of in oil, placing a waxed paper around the stopper to exclude all injurious elements. Others taking part in this discussion were E. E. F. Creighton, Charles Fortescue, G. H. Cole and R. C. Fryer.

A New Crest Voltmeter Developed

In a paper entitled "Measurement of Transients," F. E. Terman described a new type of transient-crest meter and listed applications suited to its use. The new meter utilizes the vacuum tube and goldleaf electroscope operations. It consists of a goldleaf electroscope in series with a rectifying device and an electron tube which enables the electroscope to charge but prohibits discharge. The charge that is captured in this manner is proportional to the maximum impressed potential, and where adequate insulation is possible will remain substantially undiminished for many seconds or even minutes after the transient has passed by.

The crest meter has already served successfully in

several investigations. The first application was the measurement of the potential of the sphere electrode of a high-voltage oscillator. The method followed consisted in measuring the charging current to the sphere by means of a shielded electroscope resting within this electrode. When combined with a second goldleaf acting as relay contact to give an alarm at a given voltage, the instrument is admirably suited for the study of transmission-system disturbances, for the observer need be tied no closer to the test than to remain within hearing distance of an electric bell. Such an application was made during four months of the past summer on a 110-kv. line belonging to the Pacific Gas & Electric Company in an effort to discover the cause of apparently unprovoked flashovers which this particular line experienced from time to time. Similar applications become evident as their need arises.

TIME AND VOLTAGE MUST BE CONSIDERED

In discussing Mr. Terman's paper, Charles Fortescue stated that what was really needed for studying transient phenomena was a method in which the "voltage plus that of time" condition could be measured. The destructiveness of transients is not the result of the high voltage alone, but of a combination of voltage extended over time. Take, for example, transients set up in transformers when they are connected or disconnected from lines. Here the voltage maximum reaches three or four times the normal value, but damage is very seldom caused, because the duration of the transient is so short. In regard to the question of current lag in the electron tubes used in the device described, Mr. Terman stated that there was no lag whatsoever.

A paper on "Balance Methods in Alternating-Current Measurement" was presented by Perry A. Borden. The author pointed out the value of balance methods of measurement, discussed the different methods in a review of the subject and described how the methods were applied to measurements on an operating system. A fine bibliography of the subject formed part of the paper. This paper was discussed by Charles Fortescue, I. M. Stein and E. D. Doyle and the general opinion expressed that the methods outlined by the author could be used to advantage in many applications. The author was complimented on his thorough analysis of the subject and his good presentation of existing methods.

Practical Data on Lightning

Effect of the Disturbances in Twenty Transformer and Six Generator Failures and Seven Faults in Other Apparatus Related

PRESENT-DAY apparatus for protection against dangers caused directly or indirectly by lightning are very incomplete and far from satisfactory, according to views expressed by Sigur Rump in the *Brown-Boveri Mitteilungen* for November and December of last year. He has undertaken an exact investigation of all lightning disturbances coming to his knowledge, developed a general theory of the cases and arrived at conclusions concerning the best protection for each trouble. A total of twenty transformer failures, six generator failures and seven faults on other apparatus were studied.

Flashovers in transformers appeared almost exclusively between coils or between layers—very rarely between turns—and occurred mostly when the transmission line lashed against ground. The end turns were damaged mainly in small transformers (below 70 kva.), while on larger machines the burn-out occurred most frequently toward the middle of the winding. Oil-immersed transformers suffered much less from flashovers, because many overvoltage disturbances are of a very transient character and because it takes an appreciably longer time to puncture a gap under oil than it takes in air. It was found that punctures between the end turns are due to waves with a steep front, while failures in the middle of the winding are caused by internal oscillations within the transformer. Failures between phases have never occurred. A hypothesis is developed to explain the generation of traveling waves with flat and with steep fronts along lines within the field of a thunder cloud. Only a direct hit into the line will, as a rule, cause waves with steep fronts, according to the article. An attempt is made to explain how internal oscillations occur in transformers and how electromagnetic pulsations in a winding may be responsible for a breakdown between coils at any part of the coil stack.

THREE CAUSES OF LIGHTNING DISCUSSED IN DETAIL

Three typical lightning cases which occurred in practical service are related, with all details. One caused an arcing ground, the second set off a train of steep front waves, and the third was a direct hit into a line. Experiences with high-tension lines seem to indicate that lines above 100,000 volts suffer rarely, if ever, from lightning troubles and do not need any protective apparatus. The magnitude of steep-front waves in plants of less than 100,000 volts may easily reach, and in many cases exceed, the flashover voltage of the line insulators. The best protection for these plants and lines would be the complete prevention of the occurrence of overvoltages, such as is afforded by one or more ground cables above and along the entire line, provided that steel towers are used. But this would be far too expensive. It has been tried in vain to block the passage against surges with small choke coils of the so-called "bedspring" type (inductance usually between 0.1 millihenry and 0.5 millihenry). In some cases these coils have even increased the electric stresses. Horn-gap arresters with a resistance in series have been suggested, but they were found to be useful only below 15,000 volts. Theoretical considerations proved that if the ohmic resistance of the gap is considerably larger than the wave resistance of the line, the protective value of the horn decreases to zero.

CHEMICAL ARRESTERS CONDEMNED

The chemical arresters are of little use, because their start depends upon the puncture of a solid dielectric, which takes too long a time to be of any value for quick transients. In many power stations feeding high-voltage lines nearby power consumers are frequently supplied directly with the generator voltage. This, the author points out, is a dangerous practice, because overvoltage troubles on these subordinate branch lines are apt to endanger the main generators. For such cases a one-to-one ratio transformer is recommended, acting merely as an insulating transformer. In the worst conditions possible an incoming overvoltage may burn out this small and inexpensive transformer, but it prevents harm to the costly main generators.

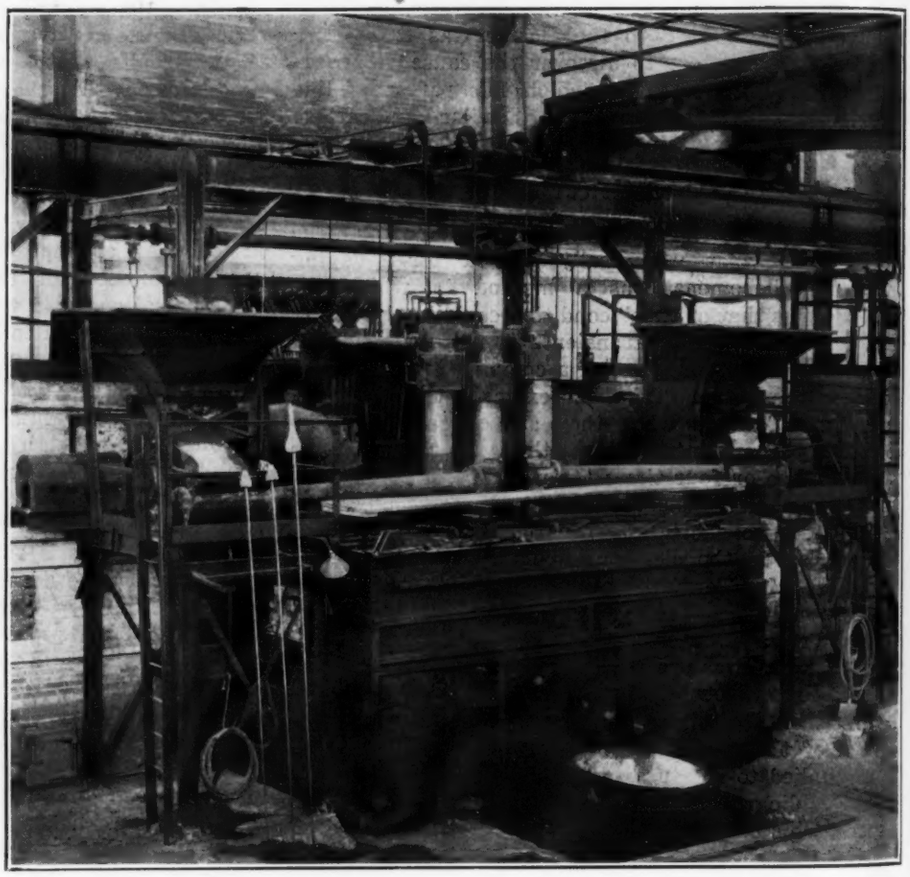
Electric Furnace Makes Ferro-Vanadium

Description of a New Electrometallurgical Process for the Reduction of This Material by Carbon—Operation Has Been Made Possible by the Development of a Type of Electric Furnace Different from Those Previously Designed

By B. D. SAKLATWALLA* and A. N. ANDERSON†

BY A SERIES of experimental and analytical electrical developments it has been made possible to attain physical electric furnace conditions for the carrying out of a chemical reaction hitherto not commercially possible. Not only has this electric development substituted coke in place of expensive metallic reducing agents but it has also made feasible the reduction of low-grade raw materials. Probably in no other electric furnace operation are materials treated which carry not more than from 2½ to 3½ per cent of the element to be reduced and a commercial product obtained in a single smelting operation.

The commercial production of ferro-vanadium has until very recently been carried on by means of metallic reducing agents such as aluminum and silicon, the former as a self-propagating exothermic reaction without the aid of extraneous heat, the latter in an electric furnace. The cost of such metallic reducing agents has necessarily been excessively high. The attempt, therefore, to reduce vanadium by means of carbon seems natural, and such efforts date back to several years. Moissan as early as 1894 attempted to reduce vanadium in his electric furnace without success, obtaining a highly carbonaceous product, the major portion of it being a carbide. Efforts in this direction by others seem to have been equally fruitless.



THE 80-TON, 4,000-KW. FURNACE USES THREE 12-IN. GRAPHITE ELECTRODES. ROLLERS PERMIT EASY MOVEMENT FOR RELINING OPERATIONS

The underlying reasons for the difficulty of reducing vanadium by carbon may be ascribed to two main factors—the high temperature of reduction and the great chemical activity of vanadium at such high temperatures. Further, vanadium exists in several forms of valency, producing different oxides with greatly varying degrees of refractoriness and reducibility. In working out a successful process these factors were kept in view and conditions established during the process such as to overcome the inherent deficiencies. The high temperature of reduction was met by designing a small crucible with close spacing of electrodes, causing a very high power input per unit of crucible section. To offset the chemical activity of the metal the furnace was so designed that the reduced alloy after it had been converted to the metallic state instantly left the high-temperature reduction zone into which the mixture to be reduced was fed. The property of changing valency and consequent variability of the oxide to be reduced was taken care of by carrying out the reaction rapidly and not allowing a gradual transition from a higher to lower oxides before ultimate reduction to the metal itself. The instantaneousness of reaction was achieved by producing an extremely localized high-temperature zone into which the mixture was directly fed.

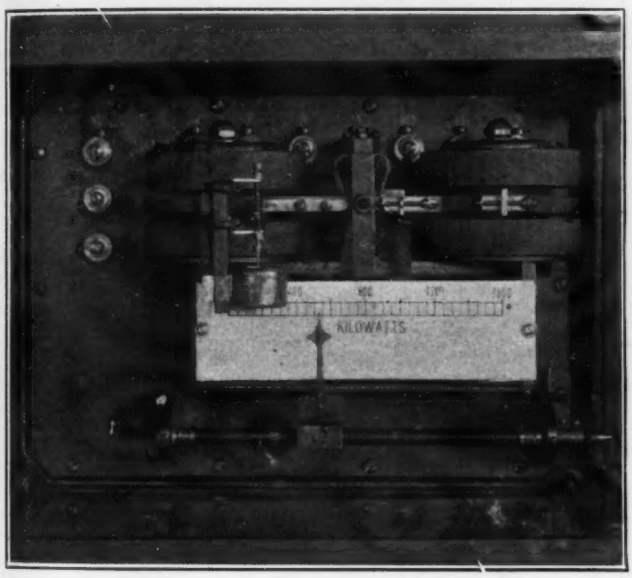
The actual experimental work was started along these lines by building a small 100-kw. two-electrode furnace. The next step consisted of a 750-kw., three-phase, 60-cycle furnace, from which the commercial operation has been standardized to a 4,000-kw., three-phase, 60-cycle unit. The voltage originally employed on the experimental furnace was 30 at the start, which was later increased to 90, 110 and 170, and finally standardized

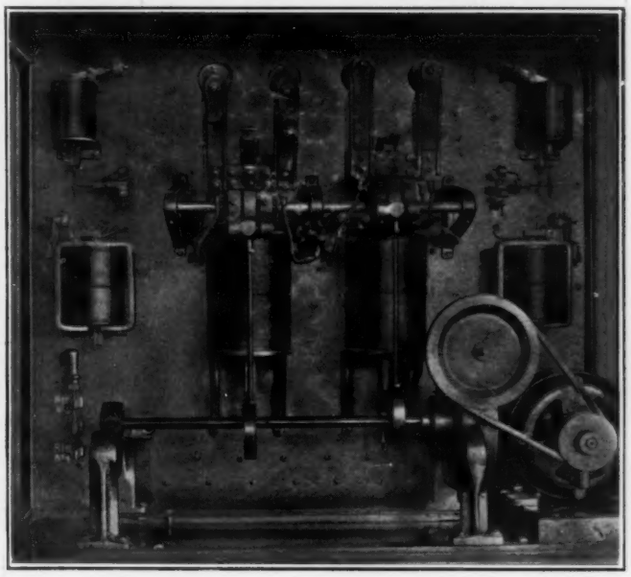
*General superintendent Vanadium Corporation of America.
†Assistant general superintendent Vanadium Corporation of America.

at 220 volts on the commercial units. It was found that the increased voltage gave more efficient results. The first experimental furnaces were of the open type, which were later supplemented by a covered unit. On account of the high temperature prevalent in the operation, the cover is water-cooled by means of coolers built in between the brick courses. The feed is charged into the furnace in a pulverized and thoroughly mixed condition by means of two automatic feeders which deliver the material between the electrodes into the hottest zone of the furnace. The feed is continuous and its rate is regulated proportionally to the energy input in the furnace. The slag-forming fluxes are selected of such a nature as to possess electric properties enabling the electrodes to dip into the slag bath so that the arc will not be exposed but submerged.

The furnace shell is made up of cast-iron segments bolted together. The lining consists of a 4-in. layer of brick all around next to the shell, followed by carbon blocks and a rammed-in mixture of coke, tar and pitch, forming a total thickness of about 44 in. Tap holes are provided for metal and slag. The over-all dimensions of the 4,000-kw. unit are approximately 16 ft. 4 in. x 12 ft. 8 in. x 7 ft. 10 in. high. The total weight of the furnace together with cover is approximately 80 tons. The three electrodes used are graphite, 12 in. in diameter. As it was desirable to interrupt the continuity of the operation as little as possible, the furnace was placed on two sets of rollers at right angles to each other, so that when the furnace needed relining it was rolled out from its position and a spare one already lined rolled in in its place, thus obviating the necessity of leaving the electrical equipment idle. This change of furnace can be effected in less than two hours and helps keep up the load factor of the installation.

For the same reason an electrode holder was designed which would curtail the time of electrode changes. The holder used works on the friction-contact principle, eliminating all bolts, nuts or other tightening devices. It consists essentially of three members—(1) the outer casing of copper, forming a hollow water-cooled ring connected to the transformer leads and having a slight taper on the inside; (2) a copper ring fitting inside the water-cooled ring and having its outside surface tapered to conform to the inside surface of the first member; (3) bronze wedges which fit between the second member and the electrode. In operation the second member is applied to the electrode by means of the wedges, this taking place on the furnace-room floor, and the electrode thus provided is lifted with the crane and simply dropped in the water-cooled first member, making a friction contact by its own weight. The advantage of this device, besides saving time, is that it obviates the necessity of loosening or tightening bolts or other devices on the top of the furnace where the working conditions are disagreeable. Further, should the holder get hot, as the water-cooled outer ring and the graphite electrode do not expand, the only material that can expand would be the second member ring and the wedges, which would produce a tighter contact, instead of a looser one, as in the case of holders of the ordinary type.





ELECTRODES CONTROLLED BY KELVIN BALANCE

Voltage control is obtained by means of a watt balance of the Kelvin type. A watt fluctuation causes one of the contactors to close one of the auxiliary contactors, while the other auxiliary contactor continually opens and closes through the motor and cam mechanism. These devices control the electrode motors and give very accurate adjustments.

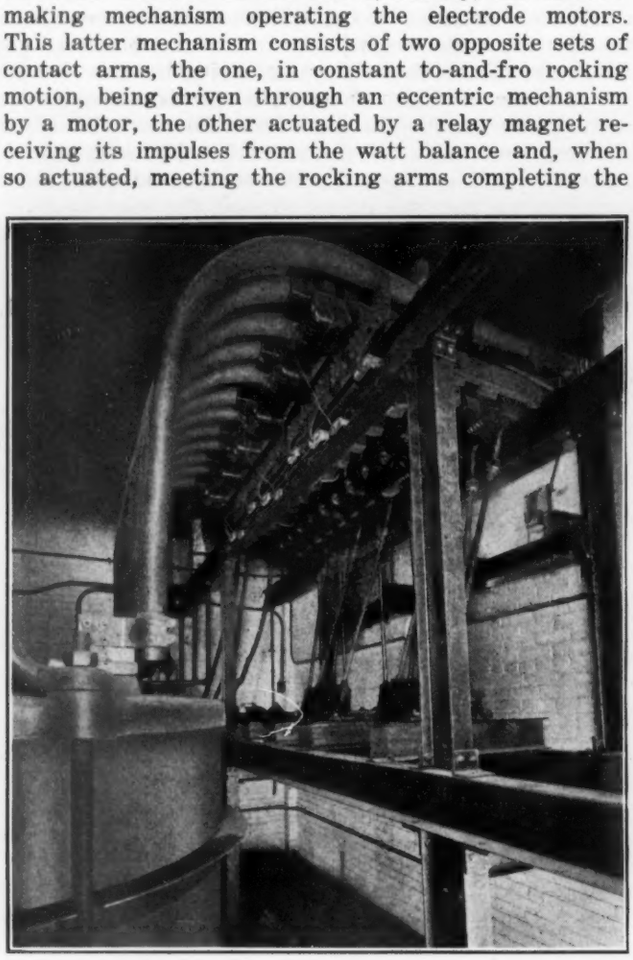
Owing to the feed being continuous and delivered immediately at the arcs under the electrodes, it is apparent that the change in electrical properties of the material at the arc will vary constantly. Combined with this, the fact that a very high temperature had to be constantly maintained to effect the reduction more or less instantaneously rendered it necessary to apply an automatic current-control system which would be capable of very close regulation, quick current rectification and high sensitiveness to very slight fluctuations. In order to keep the high temperature constant, it was considered necessary that any regulating device should not be actuated by either amperage or voltage alone but by both simultaneously effecting a true wattage regulation, thereby maintaining a truly constant energy input into the furnace. With these factors in mind the regulating mechanism described below was designed and constructed jointly by the authors.

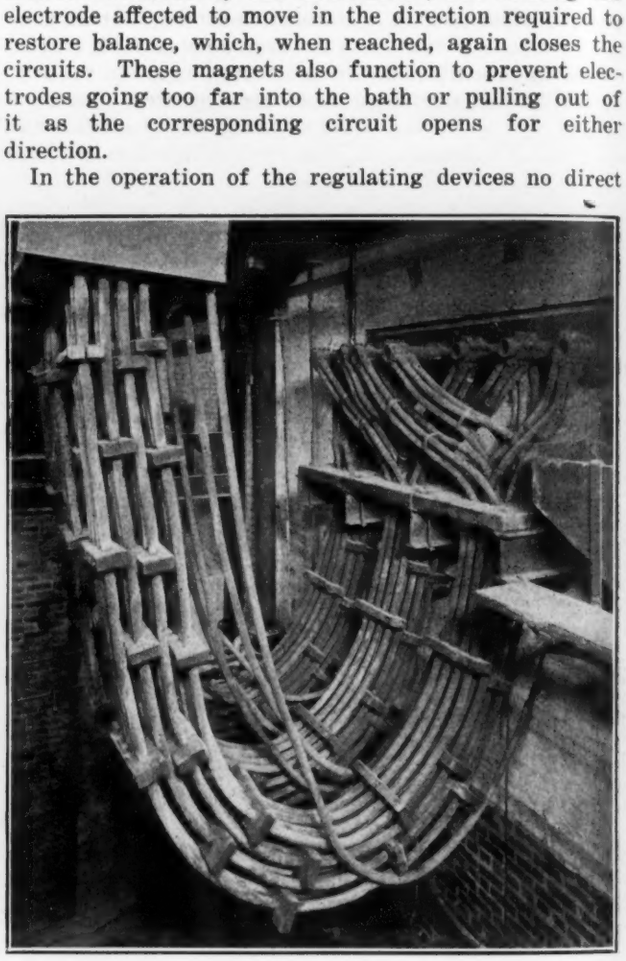
The device consists in the main of two separate members, a watt balance and a control contact-making

mechanism. The watt balance is of the Kelvin type, consisting of a balance beam carrying a volt-actuated coil at each end balanced between two fixed ampere-actuated coils. At a predetermined wattage the beam coils are floating in balance. As soon as any watt fluctuation occurs the beam is inclined out of balance, making contact at a two-way contact point in one direction or the other, actuating from these contact points the other member of the device, namely, the contact-making mechanism operating the electrode motors. This latter mechanism consists of two opposite sets of contact arms, the one, in constant to-and-fro rocking motion, being driven through an eccentric mechanism by a motor, the other actuated by a relay magnet receiving its impulses from the watt balance and, when so actuated, meeting the rocking arms completing the circuit for operation of the electrode motor. The motion of the non-rocking arms is controlled by means of very fine adjustments which allow them to meet the rockers during the desired part of the arc described by them, the speed of the rockers at the same time being variable. By means of these regulations the period of contact of the arms and duration of circuit closing on the motors can be regulated to a great degree of nicety, avoiding unnecessary movement of the electrodes. Further, to facilitate quick regulation and restoration of balance in the furnace a "selective regulation" device is applied. When one of the electrodes is out of balance this device throws the other two electrodes out of the regulating circuit and holds them in their position while the unbalanced electrode finds its adjustment, thereby restoring right operating conditions in very much quicker time. The "selective regulation" device consists of magnetic relays, star-connected across phases, two magnets being present per phase for up-and-down motion of the electrodes, with a common neutral connected to the furnace. When the load in the furnace is balanced the magnetic pull on these relays is balanced and a contact-making switch in the watt-balance circuit is closed. Phase unbalance in the furnace load causes a corresponding disturbance in the relays, opening the circuit not affected by the disturbance because of potential differences between electrode and furnace bath, preventing movement of the electrodes unaffected by the disturbance, but causing the electrode affected to move in the direction required to restore balance, which, when reached, again closes the circuits. These magnets also function to prevent electrodes going too far into the bath or pulling out of it as the corresponding circuit opens for either direction.

In the operation of the regulating devices no direct current is used for relay or operating circuits. The current used for these purposes is that delivered to the furnace and at the voltage at which it is used in the furnace.

As the current input of the standardized units is rather high—namely, 4,000 kw. for 60-cycle current—care was taken in the layout of the secondary structure to minimize losses. Comparatively little has been published on conductors carrying heavy currents at 60-cycle frequency. The literature on skin effect has been confined chiefly to currents of high frequency, although this effect is admittedly present in conductors carrying large currents. To arrive at practical conclusions eight different systems of bus structure of combinations of flat strips and tubes were mathematically investigated. Results of these calculations offered two systems as the most promising, the one consisting of ⅛-in. x 4-in. copper bars interlaced in 1, 2, 3 phase order, spaced ½ in. apart, the other of 3-in. extra-heavy copper tubing interlaced and spaced 7 in. center to center. The flat-





LEFT—TUBULAR CONSTRUCTION GIVES RIGIDITY WITH LESS TRANSMISSION LOSS FOR THE 60-CYCLE SUPPLY.
RIGHT—FLEXIBLE CABLES ARE CONNECTED TO FURNACE TUBES AND THE USE OF SPACING BLOCKS PREVENTS SWAYING OF CONDUCTORS

strip system indicated a reactance volt drop of 0.6 per cent and a watt loss of 0.41 per cent; the tubing gave a calculated reactance volt drop of 2 per cent and a watt loss of 0.2 per cent. Both calculations were based on a current density of 800 amp. per square inch and current at 10,000 amp. to 12,000 amp. per phase. Wide differences in reactance-volt drops were found in the several systems, varying from 0.6 per cent at unity power factor to 35.5 per cent at a power factor of 60 per cent. The tubular construction was chosen because it promised less actual transmission loss than the other systems and offered a rigid and simple contrivance.

The transformer used is of the three-phase water-cooled type with a primary voltage of 22,000 and a secondary voltage of 224 at no load and 220 at full load, the capacity being 4,000 kva. at 40 deg. rise and 5,000 kva. at 50 deg. rise in temperature. There are two secondary coils per phase, and leads are brought out in 1, 2, 3 phase order to the secondary terminal block. The conductors on the secondary side of the transformer, consisting of twelve 3-in. extra-heavy copper tubes, are led out through the transformer vault wall into the furnace room. A set of switches on these conductors enables "deadening" of the system extending into the furnace room, at the same time keeping the transformer "alive" for serving power for general plant operations. From these 3-in. copper tubes the current is led for each phase by means of sixteen 1,000,000-circ.mil asbestos-cored flexible copper cables into two extra-heavy copper tubes, 5 in. in diameter and 8 ft. long, running across the furnace to the electrode holder and carrying the cooling water to the holder. The flexible cables are connected into the 5-in. tube in such a manner as to form the "delta" at this point, and the spacing of the flexibles is so arranged that leads carrying current of opposite sign are placed adjacent. This method is carried out throughout the entire system of cables, both with respect to leads carrying current to and from the same electrode and also with respect to adjacent leads between phases, so that the instantaneous current values are always opposite in sign. The flexibles are held in proper position and spacing throughout their length by means of spacing blocks. These blocks serve very materially to brace the cables against swaying motion without interfering with the up-and-down motion.

Results obtained by this system of heavy-duty 60-cycle transmission were very gratifying, materially reducing the total impedance of the circuit. Actual tests were made at full load on the equipment, and the average of several determinations showed that the drop in potential from transformer terminal to electrode holder, the length of the leads being 50 ft., was only 3 volts, the power factor being 98 to 99.7 per cent and the total over-all efficiency, including transformer losses, 98.5 per cent. During these tests it was noticed that the highest power-factor and lowest voltage-drop readings were obtained when the electrodes were all of even length, and the worst results were obtained when one of the outside electrodes was more than 4 ft. longer than the rest. The impedance in the circuit rises on heavy overloads, the calculated reactance voltage drop reaching 17 per cent at 60 per cent power factor, thus tending to protect the equipment on overloads.

SEPARATE CONTROL ROOM IS USED WITH PEDESTAL MOUNTING OF INSTRUMENT

The entire control mechanism is placed outside the furnace room in a separate control room, the instruments being mounted on pedestals. The instrument equipment per furnace consists of an ammeter for each phase, a voltmeter, wattmeter, power-factor meter, frequency meter and watt-hour meter. On the first unit installed, in order to study the operation easily, all the instruments selected were of the recording type. The component of each furnace is protected automatically by overload and no-voltage relays which open oil circuit breakers. In addition, the incoming power lines, of which there are two sets, are equipped with oil switches automatically opened on overload and reverse current. Two sets of lightning arresters, one for each set of lines, afford further protection. All switches and operations of control are so equipped as to be changed instantly from automatic to hand manipulation.

The electrodes are controlled by motors provided with two speeds, the operating speed, 2½ ft. per minute, being readily alterable to a speed of 5 ft. per minute for changing electrodes or other similar purposes which often occur during the operation of furnaces of this character.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

The "Net Price Versus List and Discount" Argument

To the Editors of the ELECTRICAL WORLD:

The recent article in your "Manufacturing and Markets" section on "Net Prices Versus List and Discount" sets forth a line of argument that is quite familiar to the manufacturer whose product is handled through the electrical jobber. The fact that it has made no impression on the manufacturers is because the argument is fallacious. What the jobbers seem unable or unwilling to comprehend is that because they *buy* at list and discount they are not therefore compelled to *sell* at list and discount. They also seem to argue that because they buy fifty or a hundred articles at 50 per cent discount they are obliged to sell them all at 40 per cent discount, apparently trying to make it appear that it is easier to quote a separate net price on each of the fifty or one hundred articles than it is to separate the articles into, say, three groups according to the rate of turnover, quoting respectively discounts of 40, 25 and 10 per cent on the different groups as necessitated by conditions.

Let us consider further the second example mentioned in your article, namely, push-button switches. Our company does not manufacture this line of commodity, but let us suppose that the prices at which they are being sold today to the jobber are respectively 35 cents less 49 per cent for the single-pole switch and $2 less 27 per cent for the four-point switch. These figures are not far from the actual prices quoted today, and there is no doubt that the manufacturer has taken care of himself in the matter of turnover when he charges eight times as much for a four-point switch as for a single-pole switch. But what possible difference can it make to the jobber when it comes to his reselling these two devices whether he buys them at the above-mentioned lists and discounts or whether he buys them respectively at $17.85 per 100 and $146 per 100, which are the "nets" of the above lists, and discounts? The single-pole switch is perhaps one of two articles which the jobber buys at 49 per cent, whereas the four-point switch is one of one hundred or more which the jobber buys at 27 per cent; but, as previously indicated, there is no obligation on the part of the jobber to sell at 15 per cent all of the articles which he buys at 27 per cent from the manufacturer.

Each jobber must determine his own turnover on every article. The manufacturer cannot do this for him. The manufacturer bases his selling price on total sales, but there are many articles which the manufacturer produces in large quantities that have a definitely localized demand. For instance, there are articles that are bought in large quantities in and around New York City and which are therefore logically resold by New York jobbers at a close price. But there is little demand and therefore a slow turnover on these devices in Dallas and San Francisco, and they should therefore be resold in those districts on a wide margin of profit for the distributor.

The real answer to this matter is that it is competition and not the manufacturer's practice that holds down the profit on electrical material. The law prohibits the jobbers from agreeing among themselves upon uniform selling prices. The jobbers would like to have the manufacturers set the resale prices, and jobber A would like to have a depth bomb set off under jobbers B, C, D, etc., whenever they deviate from the manufacturer's selling price (and incidentally select a "dud" to punish the transgressions of jobber A)—but this too is forbidden by law. The consequence is that a vast number of articles are sold on a margin of profit which is really sufficient only for a limited number of commodity items.

The question is a difficult one without doubt, but the remedy seems to be almost entirely in the hands of the jobbers themselves. Unless a considerable number of them can become accustomed to passing up orders which cannot be obtained at prices that show a profit, the remedy is probably a long way off.

F. V. BURTON.
Sales Manager.

Henry D. Sears,
Boston, Mass.

Storage-Battery Locomotives in Service

To the Editors of the ELECTRICAL WORLD:

In your issue of Jan. 20 you have a very interesting article on ash-disposal systems. In one respect, however, affecting storage-battery locomotives, your article was misleading. At the Ashley Street station of the Union Electric Light & Power Company two storage-battery locomotives are in service. These machines are the original machines installed in 1916. The battery has thirty cells divided in two compartments, and it gives absolutely no trouble of any kind. One battery five years old is still in service, the other one having been replaced about two months ago. A gasoline locomotive is available but does mostly standby duty during peak load when it is necessary to run two machines. Our experience has been that if the battery is kept clean and charged properly no trouble will result.

EDWARD R. WHITAKER.

Union Electric Light & Power Company,
St. Louis, Mo.

Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

Installing Directional Relays

POWER - DIRECTIONAL relays must operate in the predetermined direction under all classes of short circuits in addition to operating at a low voltage. The most severe test is a single-phase short circuit with a high percentage of reactance. In order to insure correct operation under all conditions, the manufacturers recommend that the relays be connected in such a manner that the current in each relay will lead the voltage across the voltage coil by a certain amount when the load on the line is at unity power factor, so that when a short circuit occurs, which will generally have a high percentage of inductive reactance, a high power factor will still be obtained and each relay will be sure to operate in the right direction.

In three-phase circuits a current lead of 30 deg. is the most easily obtained, and this is a safe value to use under practically all short-circuit conditions. If the current and voltage used for operating the relays are taken off the same point of the line, it is a comparatively easy matter to select the proper current to operate with a given voltage, but often it is found more practical to have the potention and current transformers connected on opposite sides of the power transformer, which makes it more difficult to trace the correct leads for the relays.

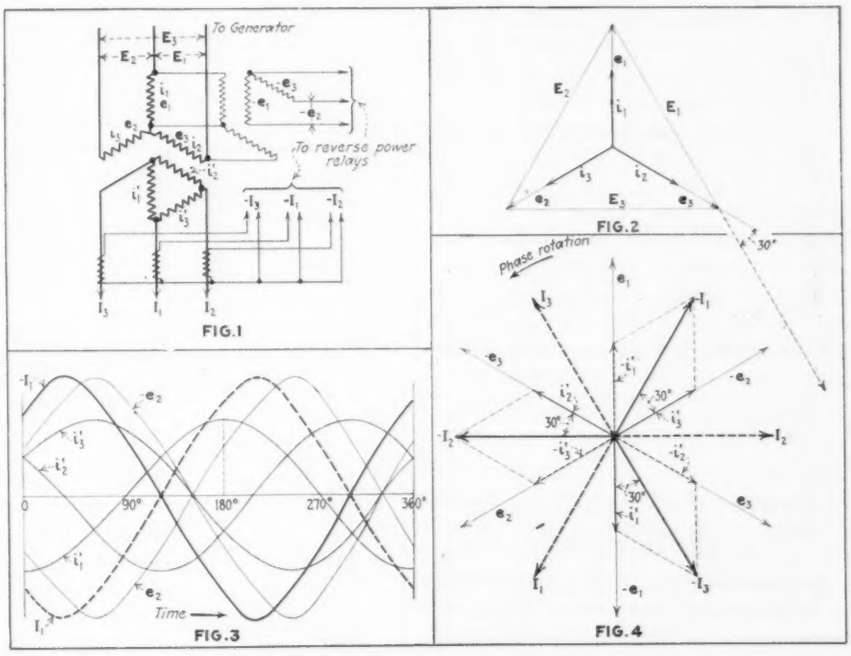
The connections of a power transformer connected star-delta, where it was desired to connect the potential transformers on the delta or low-potential side and bushing-type current transformers on the high-potential side, are shown in Fig. 1. The secondaries of the potential and current transformers were brought out for connecting to the power-directional relays to trip an oil circuit breaker in the outgoing line. The problem was to determine the proper current and voltage leads for each of the three relays.

It was, of course, necessary to know the phase rotation which was tested out and the primary power transformer leads properly marked. Fig. 2 was then drawn, giving the vector of the current and voltage at unity power factor on the primary side of the power transformer. For simplicity the arrows were drawn parallel to the respective transformer windings shown in Fig. 1. Here the voltage e_1, pointing vertically upward, is assumed at a maximum and is taken as the reference voltage.

The induced voltages and currents in the secondaries of all the transformers being taken as 180 deg. out of phase with the corresponding values of the primaries respectively, Fig. 4 was drawn, giving the phase position of the secondary voltages of the potential transformers and the secondary currents and voltages of the power transformer.

The phase position of the primary and secondary current in the current transformers represented in the diagrams by I_1, I_2, I_3 and $-I_1$, $-I_2$, $-I_3$ were also drawn. For example, it is seen from Fig. 1 that I_1 is made up of the vector difference of i'_1 and i'_3. The line I_1 —I_1 was thus located in Fig. 4. In the same manner the positions of I_2 and I_3 were determined. The curves of a few of the quantities shown in Fig. 4 are illustrated in Fig. 3.

It was now possible to select the pairs of leads going to each relay, $-e_1$ and $-I_3$ going to relay No. 1, $-e_2$ and $-I_1$ going to relay No. 2, and $-e_3$ and $-I_2$ going to relay No. 3. It was, of course, not necessary to trace the polarity of the leads from the transformers to the relays, as the current leads were connected in either direction and then the proper potential connection determined by means of a power-factor meter.



PROPER PHASE RELATIONS WHEN INSTALLING POWER-DIRECTIONAL RELAYS SECURED BY ANALYTICAL STUDY

R. RADER,
Assistant Engineer.
Puget Sound Power & Light Company,
Seattle, Wash.

Terminal Modification That Eliminates Breakdown

ON ONE transmission system in the South considerable trouble with circuit-breaker terminals used to be encountered which has been entirely eliminated by a simple modi-

fication. The trouble was experienced only in connection with circuit-breakers that opened under overload frequently. All other circuit breakers with the same type of terminals (condenser type) gave satisfactory service. The trouble was apparently due to carbon deposit from the oil building up in the steps of the condenser bushings and eventually permitting arc-over between sections of the condenser.

Application of porcelain terminal boots filled with oil and sealed to prevent entrance of foreign matter remedied the trouble. Molded integrally into the porcelain boot is a metal base which is tapped on the inside to screw onto the lower end of the circuit-breaker terminal. To the lower side of the metal base is attached the circuit-breaker contact. The boot is filled with switch oil and a cork bushing clamped onto the top.

Seven switches the terminals of which have been so equipped failed thirty times in one year before modification, but have given no trouble attributable to the terminals since then—a period of eighteen months.

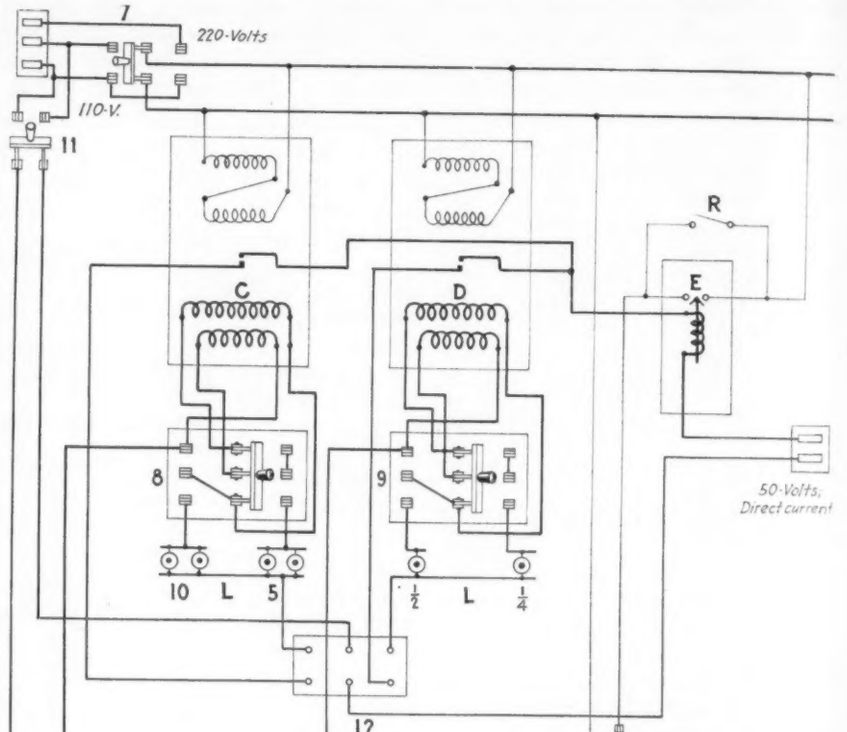
It is desirable to emphasize that this modification was not considered necessary on circuit breakers which open under overload infrequently.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Calibrating Five Meters Simultaneously

ALL meters, new and old, receive a pre-installation test at the laboratory of the United Illuminating Company in New Haven, Conn., and to facilitate this work and cut down time in testing smaller sizes a special board has been designed as shown in the accompanying illustrations. Five 5-amp. or 10-amp., 110-volt or 220-volt meters are tested at once. The board is equipped with spring points so that the weight of the meter under test makes the necessary circuit completions. Potential cords are snapped upon the test links with which all modern meters are provided. The equipment consists, in brief, of five vertical panels carrying the tested meters and necessary terminal blocks, a large panel carrying two master meters, switches and a contact-making relay in the center. This last receives impulses from the master meter in use at any particular time and transmits the impulses to the potential circuits of the meters under test and controlling the revolutions of the tested meters within a predetermined number of turns.

In the operation of the board, assuming that a lot of 5-110-I-14 meters are to be tested, the No. 7 potential switch (see key) is thrown for 110 volts. The master meters *C* and *D* are set for 110 volts, and the rotating standard meter *B* is set. The load switches Nos. 8, 9 and 11 are thrown to the right, giving loads of 5 amp. full and ¼ amp. light. The tester then throws switch No. 12 to the left, which puts full load on master meter *C*, all meters under test and standard meter *B*. After first checking the master meters with the rotating standard, the latter is removed and plug *N* substituted to prevent any accidental short circuit affecting the standard. The master meter *C* controls through relay *E* the potential circuits of the meters *A*, *A*, *A*, etc., under test, so that these make three revolutions after the master meter makes four more revolutions; the *A* meters make three revolutions again, and so on until all meters have been adjusted 100 per cent. Switch No. 12 is then thrown



TEST BOARD CONNECTIONS FOR TESTING FIVE METERS AT ONCE

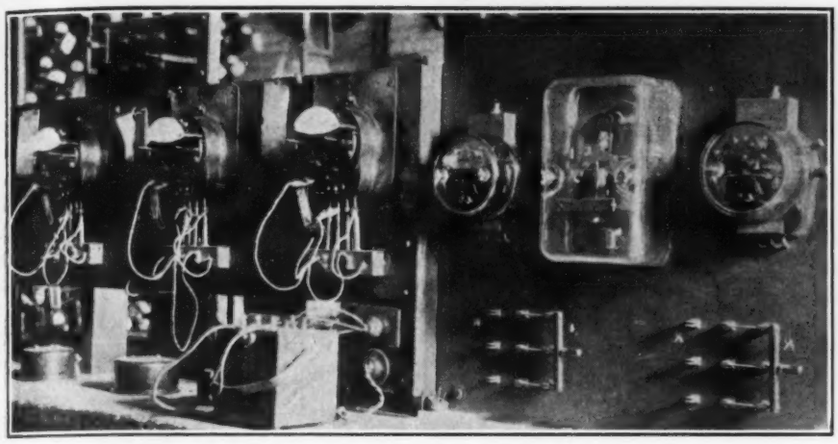
A—Meters under test.
B—Portable standard test meter used to set master meters.
C—Make-and-break master meter, 5 amp. to 10 amp., 110/220 volts.
D—Make-and-break master meter ¼ amp. to ½ amp., 110/220 volts.
E—Relay for opening potential on meters under test.
L—Lamp-bank loads.
N—Three-pole plug receptacle for cutting in *B*, to be plugged with short-circuited plug when *B* is not being used.
P—Single-pole switch for cutting out potential on *A* and *B*.
R—Single-pole switch for cutting out relay, *E*.
7—Double-pole double-throw switch for potential circuit.
8—Triple-pole, double-throw switch for connecting coils of *C* in multiple or series.
9—Triple-pole, double-throw switch for connecting coils of *D* in multiple or series.
11—Double-pole, single-throw switch on current circuit.
12—Double-pole, double-throw switch for throwing meters under test on master meters *C* or *D* (located near operator).

NOTES

C—Master meter, three-wire, equipped with 5-amp. current windings arranged for series-multiple connection, and with potential windings arranged for both 110-volt and 220-volt circuits. Meter provided with special make-and-break mechanism for controlling the potential circuit of meters under test, arranged so that the potential is on such meters during three revolutions of master meter and off during four revolutions of master meter.

D—Master meter, three-wire similar to *C*, except the current windings, which are ¼ amp., arranged for series-multiple connection. This meter makes twenty revolutions to one of meter under test.

E—Special relay, one end taking the impulse from whichever master meter is in use. The other end transmits the impulse to the potential circuits of meters under test.



ALL METERS OF THE UNITED ILLUMINATING COMPANY OF NEW HAVEN, CONN., RECEIVE PRE-INSTALLATION TEST

to right to apply the light load and the master meter *D* is used.

The number of meters tested in a given time depends on how the meters average as to accuracy and what adjustments are required. With new meters needing very little adjustment we have been able to test and stock 100 to 150 and sometimes as high as 200 per day. This board can be controlled by one man, using two men to help with meter covers when rushed. As to the accuracy of the master meters *C* and *D*, these can be set to make the standard stop on zero continuously. In fact, an error of one-tenth of 1 per cent can be adjusted. Practically all types of meters can be tested by the board, which has given complete satisfaction since its installation by the company.

R. S. HINMANN,
Meter Department.
United Illuminating Company,
New Haven, Conn.

Extracts from Operating Code

BY FIELD EDITOR ELECTRICAL WORLD
New York, N. Y.

Instructions for Operating Boiler Accessories

WHEN dumping fires in boilers the rear dampers must be opened and the forced draft closed to prevent a flareback of the fire on account of the accumulation of gases. The ash spray should be opened to prevent excessive formation of gas in the ash pit and the burning out of the brick lining. Excessive formation of these gases may be prevented by dumping the plates in sections. Rules 8, 9 and 10 of "Detailed Instructions for Boiler-Room Force" (ELECTRICAL WORLD, Feb. 3, page 282), referring to inspection, rapidity of dumping and the handling of large clinkers, also apply to this section. The following instructions have been abstracted from the operating code of the Philadelphia Electric Company:

1. Cut off the forced draft.
2. Open the back dampers wide.
3. Stop the stoker.
4. Open the ash-spray valve.
5. Dump the plates in sections.
6. Reduce the rate of water feed, if necessary.
7. Clean the fires, being careful not to throw good coal down with ashes. If there is much coke over the top of the clinker, close the dumps before hooking out the clinker.
8. Raise the dump plates.
9. Adjust the forced and stack drafts for load.
10. Start the stoker.
11. Shut off the ash-spray valve.

Fuel economy and low stoker maintenance costs result, in a large measure, from proper operation of the clinker-crusher apparatus. Continuous operation is very necessary. Stopping the crusher while the stoker continues to push ashes to the crusher pit may cause the ash to fuse to the stoker parts of the crusher pit and burn them, while a speed higher than required may grind the ash entirely away and produce an empty crusher pit. Any burning fuel which may then fall into the crusher pit is liable to damage these parts.

1. Operate the clinker crusher continuously, according to the conditions of the fire, by adjusting the speed to keep two feet of ashes over the crusher. Do not start and stop.

2. The crusher doors should be set to the proper opening by the boiler engineer when the boiler is off and should not be changed without his knowledge or the knowledge of the water tender or boiler operator. Any change made in the opening must be reported to both the engineer and the shift superintendent.

3. The boiler engineer should make inspection every morning and evening.

In operating soot blowers on boilers, economizers and induced-draft fans the blower manifold line should be warmed up and drained of moisture which may form in it previous to blowing tubes in order that dry steam only will be blown into the tube nest. Moisture will cause soot to adhere to tube surfaces.

SOOT BLOWERS ON BOILERS AND ECONOMIZERS

1. See that the drains on the soot-blower supply manifold are open.
2. Crack the main steam valve and blow the water out of the manifold.
3. Close the drain.
4. Open the main steam valve wide.
5. Open the soot blowers in rotation, beginning with the first pass.
6. As the unit is being blown, rotate the blower between the stops provided on the main wheel or on the hand wheel.
7. After blowing, close the main steam valve to the manifold.
8. Open the drain on the manifold and leave it open.

SOOT BLOWERS ON INDUCED DRAFT FANS

1. The fan should be running at lowest speed when soot blowers are opened.
2. See Rules 1, 2, 3, 4 and 7, above.

Turbo-Generator Operation

WHEN shutting down a turbo-generator the load should be reduced to a low value to prevent a sudden rush of load from being thrown upon other machines, which might disturb the voltage of the system. The power factor should be adjusted to unity in order to reduce the amount of current passing through the machine to a minimum for the load carried, thus causing a minimum disturbance to the other machines when the main oil switch is opened. Reducing the field current to a minimum after the main switch is opened will prevent a bad arc from forming when the field circuit is opened. The successive steps in shutting down a machine follow:

1. Signal "Stand by."
2. When the "Stand by" signal is answered, reduce load to a low value.
3. Adjust the power factor to unity.
4. Signal "Stop."
5. After receiving an answer and upon noting a further decrease in the wattmeter reading, showing that the throttle has been closed on the proper machine, open the main and bus oil switches simultaneously.
6. Reduce the field current to a minimum.
7. Open the field-break switch.
8. When a bracketed exciter is used for excitation open the exciter circuit breaker.

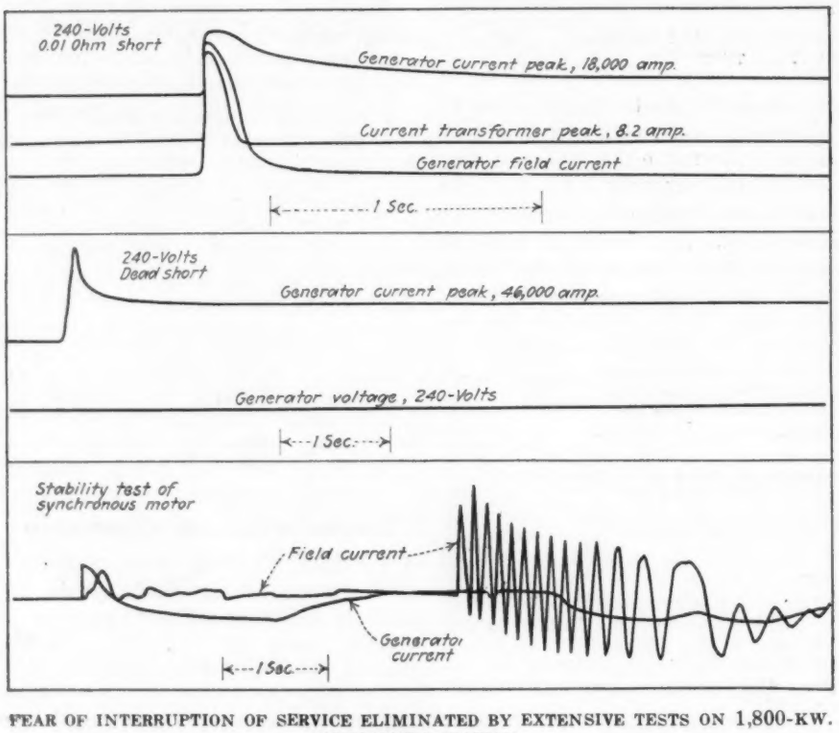
Favorable Test Results on Automatic Substation

A COMPLETE service restoration test with oscillograph records was made on the 1,800-kw. synchronous motor-generator set and automatic switching equipment recently installed by the Union Electric Light & Power Company of St. Louis. The test was successful in every detail of performance of the motor-generator and functioning of the automatic switching equipment. This is one of the first automatic motor-generator sets for Edison three-wire service to have performed completely a service restoration test under conditions more severe than are likely to be met in commercial operation. A noteworthy feature of this installation is that this severe test fails to disclose a necessity for making any changes whatever in the motor-generator set itself and nothing more than adjustments was needed in the automatic switching. These adjustments were made after the oscillograms shown were taken.

The equipment comprises standard types of motor and generator. The generator has compensating pole-face windings, is of the shunt-wound type and is separately exited from a directly connected exciter. No differential or other special windings are employed.

The automatic control is equipped with a complete regulating equipment and with quick-acting generator-field control for short-circuit conditions. Means are also provided for pulling the motor back into step after a serious surge on the alternating-current supply system without having to drop the load entirely. The tests were made to determine the adequacy of these protective and operating features.

Arrangements were made to short-circuit the generator through various values of resistance, starting with 0.01 ohm and reaching a value as near zero as could be obtained with a 6-in. x ¼-in. copper bar. The short circuits were thrown on with a knife switch closed by a heavy weight. Oscillographic records were obtained of all tests, some of which are reproduced herewith.



FEAR OF INTERRUPTION OF SERVICE ELIMINATED BY EXTENSIVE TESTS ON 1,800-KW. AUTOMATIC STATION

Top—When terminals of generator were shorted through 0.01 ohm, the current rose to 18,000 amp. Relays then operated and inserted 150 ohms in field circuit, which reduced the generator current as shown by the oscillographic record. Center—After a dead short circuit the machine was still ready for operation. Bottom—Stability test, consisting of loading machine, opening high-tension feeder and then closing after two and one-quarter seconds and noting effects.

At no time were the direct-current breakers opened until the completion of any one test. The short circuit was thrown on and allowed to remain until the load on the generator had been reduced to 125 per cent full-load amperes by the functioning of the constant-current regulator. In one of the first tests, with the terminals of the generator shorted through 0.01 ohm, the current rose to 18,000 amp. The current transformer in the main direct-current circuit had a normal ratio of 10,000-5 on alternating current, and the current in the secondary of this transformer on this test reached a value of 8.2 amp. This current trips the short-circuit-detecting relay, which functions to insert an auxiliary resistor of 150 ohms into the generator field circuit.

In another test the generator was short-circuited under extreme conditions, the circuit resistance being not more than that of 12 ft. of 6-in. x ¼-in. copper bar. The generator current reduced rapidly, following the functioning of the field control. On the short circuit the generator delivered 46,000 amp. (7,200 amp. being full load) and was in condition for continuous operation. The relatively low value of short-circuit current is obtained by the arrangement of the compensating pole-face windings. There is only a momentary spit at the generator brushes at this extreme overload. The regulator was ready to restore the generator to normal voltage when the short circuit was cleared.

In a motor stability test the generator was loaded through the test resistance to approximately 125 per cent full load. The high-tension feeder was opened at the generating station. The generator being heavily loaded, the speed dropped rapidly. After an interval of two and one-quarter seconds the feeder was reclosed. Violent oscillations occurred to the motor-field current, the highest reaching nearly three times normal. Three-quarters of a second after the alternating-current feeder was reclosed the motor-slip relay operated to reduce the generator load. The motor, thus momentarily lightly loaded, pulled quickly into synchronism.

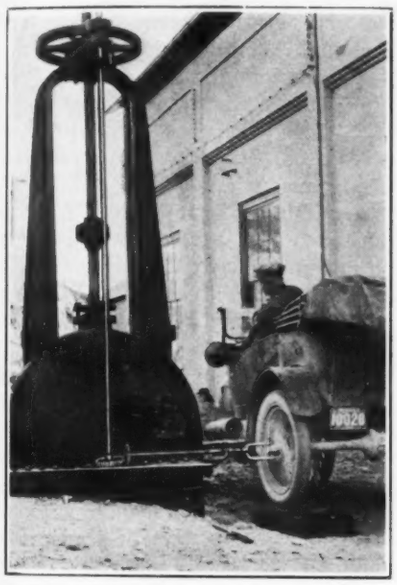
The tests, according to the engineers of the Union Electric Light & Power Company and the Westinghouse Electric & Manufacturing Company, by whom they were made, show that with a machine of similar characteristics and a control to perform the same functions, no fear need be felt that an interruption to service will be caused.

The use of such equipments should reduce the necessity for large stand-by batteries since the major use of such batteries is to tide over heavy surges on the alternating-current system and to permit of quick restoration of service.

FIELD EDITOR ELECTRICAL WORLD.
Chicago, Ill.

Hydraulic Valve Operated by Automobile

AN EFFICIENT labor-saving device used on a large hydraulic valve which is seldom operated and which does not warrant the installation of electric drive is illustrated herewith. This is used on a 48-in. gate valve on our Lahontan power house, which is leased from the government. It consists of a U-shaped



INFREQUENTLY OPERATED VALVE DOES NOT WARRANT ELECTRIC DRIVE

piece of metal spanning the hub and held against opposite spokes on the rear wheel of the automobile. This piece is in turn fastened to the pinion-gear shaft operating the hydraulic valve.

H. SHIELDS,
General Superintendent.
Nevada Valleys Power Company,
Lovelocks, Nev.

Generator Breakdown from Loose Laminations

HAVING had several breakdowns of certain generators about twelve years old, one Southern company made a careful study to determine the cause. These generators had been rebuilt, an operation in which the laminations had been restacked and reclamped. It was found that the old composition-metal finger plates which held the laminations together had been stressed beyond their elastic limit and had bent back, allowing the laminations to vibrate very badly.

This vibration gradually wore away the insulation on the bar-wound coils, but a short circuit did not ensue within the windings until two coils became grounded.

By replacing the old finger plates with new steel ones and clamping the laminations tightly the repetition of this trouble has been avoided so far.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Transformer Dielectric Tests Amplified

THE standard values for insulation test voltages on distribution transformers other than small air-cooled transformers and on power transformers were amplified by the Electric Power Club at the fall meeting at Asheville, N. C., and became effective Jan. 1, 1923. The standards now cover in greater detail the requirements for high-potential test guarantees applying to transformers having single-voltage ratings above 4,500 to 50,000 inclusive. The requirements are given in the accompanying table and in the following paragraphs:

DIELECTRIC TESTS ON TRANSFORMERS

Transformers intended for Y connection shall have their test voltages determined by the line voltage and not the leg voltage.

Dielectric tests shall be made as follows: (a) Between high-voltage and low-voltage windings. (b) Between high-voltage winding and the core. (a) and (b) may be made at the same time by connecting the low-voltage winding to the core. (c) Between the low-voltage winding and the core.

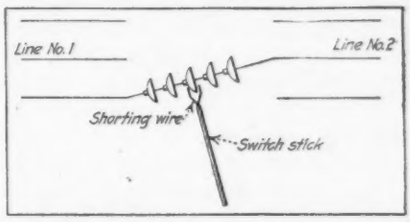
The time of application for each test shall be one minute. Measurement of voltage in making dielectric tests shall be in accordance with A. I. E. E. Sections 2358 to 2370 inclusive.

Transformer oils shall be capable of withstanding at commercial frequencies 22,000 volts between 1-in. disk terminals spaced $\frac{1}{10}$ in. apart.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Phasing High-Voltage Lines Without Instruments

WHEN two high-voltage lines from the same source are brought together it is necessary to phase out before paralleling. This phasing may be done with a string of strain insulators and an ordinary switch stick. A string of strain insulators containing one more insulator than would be required on the line is used. The string is temporarily connected to any leg of each line. Then, with the current on, "short" out one of the center insulator units with a V-shaped wire on the end of a switch stick. If a heavy discharge is noted on "shorting" the insulator the string is connected to



STRING OF STRAIN INSULATORS USED TO PHASE OUT HIGH-TENSION LINES

phases of different polarity. If a very slight discharge or none is noted, the string is connected to the same phase. By repeating this process with each phase a definite phasing out is obtained, and the results are very positive.

When the two lines are brought together at a switch structure, it is very easy to mount the string of strain insulators below the line and connect to the "hot" wires by switch sticks.

T. W. SNELL,
General Superintendent.
Coast Valleys Gas & Electric Company,
Salinas, Cal.

TRANSFORMER DIELECTRIC TEST REQUIREMENTS FOR HIGH-POTENTIAL GUARANTEES

High-Voltage Winding to Low-Voltage Winding and Core

Maximum High-Voltage Rating, Full Winding or Taps	Test Voltage
Below 550	4,000
550 to 4,500 inclusive	10,000
Above 4,500 to 50,000 inclusive	Twice the highest rated voltage* of the high-voltage winding plus 1,000 volts.
Above 50,000	Twice the normal voltage† of the circuit to which the high-voltage winding is connected plus 1,000 volts.

Low-Voltage Winding to Core

Maximum Low-Voltage Rating, Full Winding or Taps	Test Voltage
1,500 and below	4,000
Above 1,500 to 4,500 inclusive	10,000
Above 4,500 to 50,000 inclusive	Twice the highest rated voltage* of the low-voltage winding plus 1,000 volts.
Above 50,000	Twice the normal voltage† of the circuit to which the low-voltage winding is connected plus 1,000 volts.

*For transformers having single-voltage ratings a value 5 per cent above the rated voltage shall be used as the basis of the high-potential test.

†In systems of circuits employing transformers the normal voltage of the system or circuit is defined as the highest-rated voltage of the secondaries of transformers supplying the system or circuit. This voltage rating applies to all parts of that particular system or circuit.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Allocating Service Cost in Rates

Schedule Fitted to Consumer, Demand and Output Costs as Shown by a Preliminary Hypothetical Analysis— A Small-Town Example

By Herbert B. Dwight
Electrical Engineer Colorado Public Utilities Commission, Denver, Col.

THE more one studies the annual reports of electric utilities the more apparent is the truth of the statement that, in general, rates for service are not established with due consideration to the costs of rendering the service. This is contrary to the first principles of state regulation. Numerous examples are found where one or more classes of service are paying at, or less than, the cost of production. Fair return on the investment, taxes, depreciation reserve fund allowance and other general costs, and sometimes part of the cost of production, are paid from the revenues of other classes of service. Consideration given to off-peak business, exceptional load factor, competitive service and so on cannot be made to justify these low rates to favored classes of service. There is only one answer. Every utility should make such a complete analysis of all the fixed and variable costs of rendering service that these can be fairly allocated to each class of service and then rates formulated which will make the charge to each consumer vary in direct proportion to the varying costs. Proper consideration can also be given in these rates for load factor, off-peak business, etc., by determining the value of each of these factors, present and future, in the costs of production and then making suitable allowance.

The analysis preliminary to the formation of rates may be made as exhaustive as the size of the utility and the variety of service may justify. That such analysis is worth while for even a very small utility is amply illustrated by the town of Sedgwick, situated in the extreme northeast corner of the State of Colorado. This is a municipal electric utility serving a population of about four hundred. Whether an electric utility in so small a community was warranted is beside the question. The important feature is that the analysis was made and rates established in accordance therewith which have fully proved their worth from every standpoint.

It happens that this town, in a burst of enthusiasm, contracted with some Eastern company to install a complete distribution system and a 6,600-volt transmission line 16 miles to the town of Julesburg, which operates a municipal plant. At the town limits of Julesburg wholesale power was available. After the installation was nearly completed rates were considered. Assistance of the commission was sought and an analysis was made. From the analysis it appeared that rates must be abnormally high or the town would have to support the utility in part from town funds. Rates were established in line with the results of the analysis. Every one appears to have been satisfied, and the annual reports show that the revenues and expenses have been about as predicted. This analysis has been used frequently as a pattern for others and is a distinct improvement over the old method of compiling the rates of utilities in several towns considered similar and then using the average of the compilation. This old method has been the usual one, no relation between costs and revenues being considered. It was a grand combination of faith and hope—faith that the other utilities had made a proper study of their rates and hope that the revenues would prove adequate.

Preliminary to the analysis, it was necessary to study the Sedgwick situation and from the facts developed and from the data of other similar utilities estimate the various factors needed, such as operating expenses, number of consumers in each class, the probable average consumption of each class and their participation in the system peak. The known cost of wholesale power at Julesburg was 6 cents per kilowatt-hour. The part of the investment in the combined electric and water system used for the electric service was estimated at $25,000.

It should be further noted that in electric utility operation there are investments and operating costs which wholly or in part increase and decrease in proportion to the changes in the number of consumers served. Others vary in proportion to the demand the consumers produce at the time of the system peak, and still others vary directly with the average load produced. These investments, resulting investment costs and the operating costs are allocated to the proper one of these three groups.

TABLE I—ALLOCATION OF ANNUAL INVESTMENT AND OPERATING COSTS

	Consumer's Cost 18 Per Cent	Demand Cost, 62 Per Cent	Output Cost, 20 Per Cent	Total, 100 Per Cent
Investment	$4,500.00	$15,500.00	$5,000.00	$25,000.00
Investment costs:				
Interest on bonds, 5 per cent	$225.00	$775.00	$250.00	
Depreciation reserve fund, 4 per cent	180.00	620.00	200.00	
Profit, 3 per cent	.....	.....	750.00	.....
Sub-total	$405.00	$1,395.00	$1,200.00	$3,000.00
Operating costs:				
Power purchased	.....	.....	$3,000.00	$3,000.00
Distribution and general	$157.50	$542.50	$175.00	$875.00
*Sub-total	$157.50	$542.50	$3,175.00	$3,875.00
†Total costs	$562.50	$1,937.50	$4,375.00	$6,875.00
‡Total costs exclusive of depreciation reserve fund and profit	$382.50	$1,317.50	$3,425.00	$5,125.00

* Operating expenses only.
† Total costs, including profit, interest on bonds and depreciation reserve fund allowance.
‡ Total costs, excluding profit and depreciation reserve fund allowance.

TABLE II—ALLOCATION OF TOTAL COSTS TO CLASSES OF SERVICE

Class of Service	*a*—Includes Depreciation Reserve Fund Allowance and Profit on Sales				*b*—Exclusive of Depreciation Reserve Fund Allowance and Profit on Sales				*c*—Operating Costs Only, All Other Cost Excluded			
	Consumer's Cost	Demand Cost	Output Cost	Unit Charge	Consumer's Cost	Demand Cost	Output Cost	Unit Charge	Consumer's Cost	Demand Cost	Output Cost	Unit Charge
Residence lighting:												
Fifty customers (63.3 per cent)	$356.06				$242.12				$99.70			
30 per cent participation in peak		$581.25				$395.25				$162.75		
9,000 kw.-hr. load (23.0 per cent)			$1,006.25				$787.75				$730.25	
Charge per customer	(0.59)	(0.97)	(1.68)	$3.24*	(.40)	(.66)	(1.31)	$2.37*	(.17)	(.27)	(1.22)	$1.66*
Equivalent average rate	(0.0396)	(0.0646)	(0.1118)	0.216†	(.0269)	(.0439)	(.0875)	.158†	(.0111)	(.0181)	(.0811)	0.110†
Business lighting:												
Twenty customers (25.3 per cent)	142.31				96.78				39.80			
50 per cent participation in peak		968.75				658.75				271.25		
8,400 kw.-hr. load (21.4 per cent)			936.25				732.95				679.45	
Charge per customer	(0.59)	(4.04)	(3.90)	$8.50*	(.40)	(2.74)	(3.05)	$6.19*	(.17)	(1.13)	(2.83)	$4.13*
Equivalent average rate	(0.0169)	(0.1153)	(0.1115)	0.244†	(.0115)	(.0784)	(.0873)	0.177†	(.0047)	(.0323)	(.0809)	0.118†
Power:												
Eight customers (10.1 per cent)	56.81				38.63				15.91			
19 per cent participation in peak		368.12				250.32				103.08		
17,205 kw.-hr. load (43.9 per cent)			1,920.62				1,503.58				1,393.82	
Charge per customer	(0.59)	(3.84)	(20.01)	$24.44*	(.40)	(2.61)	(15.66)	$18.67*	(.17)	(1.07)	(14.52)	$15.76*
Equivalent average rate	(0.0033)	(0.0214)	(0.1116)	0.136†	(.0022)	(.0145)	(.0874)	1.04†	(.0009)	(.0060)	(.0810)	0.088†
Municipal lighting:												
One customer (1.3 per cent)	7.31				4.97				2.05			
1 per cent participation in peak		19.38				13.18				5.42		
4,600 kw.-hr. load (11.7 per cent)			511.88				400.72				371.48	
Charge per customer	(0.61)	(1.62)	(42.66)	$44.89*	(.41)	(1.10)	(33.39)	34.90*	(.17)	(.45)	(30.96)	$31.58*
Equivalent average rate	(0.0016)	(0.0042)	(0.1113)	0.117†	.0011	.0029	.0871	.091†	(.0004)	(.0012)	(.0808)	0.082†
Total costs from Table I	$562.50	$1,937.50	$4,375.00		$382.50	$1,317.50	$3,425.00		$157.50	$542.50	$3,175.00	

* Per month. † Per kilowatt-hour.

After a study of the details concerned, it was determined to be fair to use 18 per cent of the totals for the consumers' cost, 62 per cent for the demand cost and 20 per cent for the output cost for the Sedgwick situation, except that all of the operating cost for wholesale power belongs in the output group.

Summaries of the analysis used in the rate study of the Sedgwick municipal electric plant are shown in the accompanying tables.

Table I shows the preliminary allocation of the investment, investment costs and operating costs to one of the three groups.

Table II shows the subsequent allocations to classes of service under three conditions—(a) that the revenues return all the costs and a small profit; (b) that they return only the interest on bonds in addition to actual operating costs, and (c) that they return only operating expenses. In the last column of each will be found the net results of these compilations. There are shown the average monthly bill to be paid by the consumers of each class and the average price that would result per kilowatt-hour used.

From Table IIa it was apparent that the rates needed and proper would be excessive. This result is proof that this investment was not justified in so small a community with its thinly scattered business. Therefore, a suitable rate schedule was formulated which would have an average effect between those shown in b and c, and the town would expect to provide part of the interest on bonds and the depreciation reserve fund out of the town funds. Such practice is not advocated, but in this case cannot be avoided. It is, moreover, apparent that, from the relative proportions of each group of the costs for a class of service, it is possible so to proportion the sliding-scale features of the rate and the minimum charge that the effect sought by the rates will be obtained. The net rates based on the allocation of costs in Table II are shown in Table III.

In conclusion, it may be noted, as shown from the annual report following a year and eight months of operation, that there has been a decided increase of the business in each class of service over that predicted at the beginning of operations. The increase for all classes amounts to 50 per cent, and the number of consumers increased from 79 to 109. This proves the suitability of the

TABLE III—RATE SCHEDULE ADOPTED

	Cents
Residence lighting:	
First 3 kw.-hr. per "active room" per month, per kw.-hr.	18
Next 3 kw.-hr. per "active room" per month, per kw.-hr.	9
All over 6 kw.-hr. per "active room" per month, per kw.-hr.	6
Minimum per month, $1.50	
Business lighting (optional for residence consumers):	
First 15 kw.-hr. per month, per kw.-hr.	18
Next 15 kw.-hr. per month, per kw.-hr.	16
Next 20 kw.-hr. per month, per kw.-hr.	14
Next 50 kw.-hr. per month, per kw.-hr.	12
All over 100 kw.-hr. per month, per kw.-hr.	10
Minimum per month (three lights or less), $1.50	
Minimum per month (all over three lights), $2.50	
Power:	
First 20-kw.-hr. per hp. connected per month, per kw.-hr.	10
Next 20 kw.-hr. per hp. connected per month, per kw.-hr.	9
All over 40 kw.-hr. per hp. connected per month, per kw.-hr.	8
Minimum per hp. connected per month, $1.00	
Municipal lighting:	
All energy used per month, per kw.-hr.	9

TABLE IV—COMPARISON OF HYPOTHETICAL AND ACTUAL RATES, 1921

	Actual Kilowatt-hour Sales	Revenues Derived by Use of— Table IIb	Table IIc	Actual Rate Schedule
Residence lighting	12,326	$1,959.83	$1,358.33	$1,992.07
Business lighting	10,453	1,860.63	1,239.73	1,729.08
Power	26,538	2,759.95	2,319.42	*2,574.70
Street lighting	5,181	611.36	430.54	*466.29
Total	54,498	$7,191.77	$5,348.02	$6,762.14
Actual operating expenses and interest charges		6,822.08		6,822.08
Actual operating expenses only			5,222.08	
Excess		$369.69	$125.94	
Deficit				$59.94
Percentage		5.42	2.41	0.88

* These items corrected to agree with the schedule. The town did not follow the schedule for municipal service.

rates in effect. The average rate per kilowatt-hour paid by each class of service has remained over two periods of operation almost exactly the same as predicted from the rates used. Furthermore, by applying the average rates shown in Table II to the actual twelve months' consumption per class the necessary hypothetical revenue to pay the operating expenses compared with actual operating expenses shows only 2.41 per cent error. Using Table IIb, in the same manner, a comparison of hypothetical and actual results may be made with reference to operating expenses plus interest on bonds. This comparison shows an error of 5.42 per cent, which is larger than it would be if the plant had not been built somewhat in excess of present requirements. A comparison showing the results of this study is given in Table IV.

Finally, it should be remembered that this hypothetical study and the resulting prediction as to consumption, operating expenses and the effect of the schedule were made prior to the completion of the system, and over nearly two years' operation the results have been practically as predicted.

New York Edison Holds Sign Exhibition

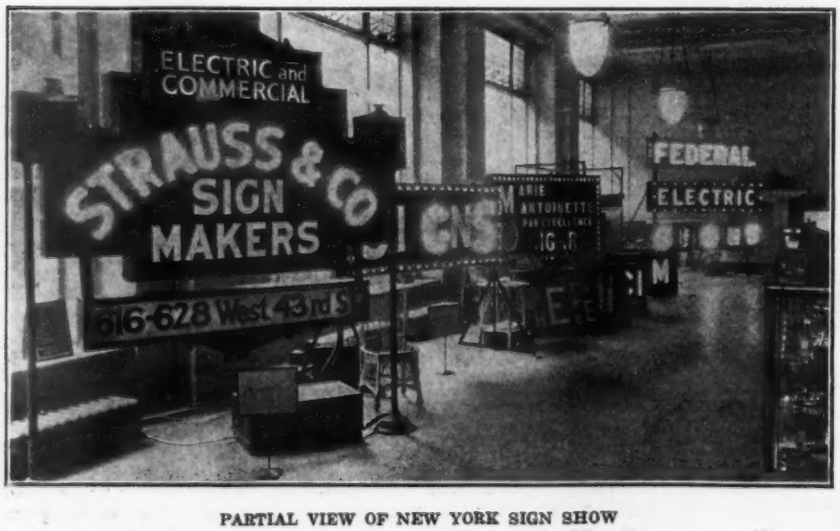
The second annual electric sign exhibition under the auspices of the New York Edison Company was held during the week of Jan. 29 to Feb. 3 in the showroom of the company. This was the first of a series of specialized electrical exhibits which the company has scheduled for this year as announced in the ELECTRICAL WORLD for Jan. 13.

Twenty-six manufacturers of electric signs and sign accessories accepted the Edison company's invitation to display their wares, and at the close of the week all reported that the show had been productive of considerable new business. A partial view of the exhibit is shown here. Many urged that the show be extended into the second week, but as other things had been planned for the showroom and as the heating show is scheduled for the week of Feb. 19 it was impossible to do this.

The Wireman and His Central Station

INTERDEPENDENCE of the electrical contractor and the electric light and power company was emphasized by C. J. Russell, vice-president and general manager of the Philadelphia Electric Company, at a recent meeting of the Electrical Conference in that city. Speaking on the subject "The Wireman and His Central Station," Mr. Russell called attention to the fact that the wireman was born ahead of the central station inasmuch as long before central stations were built the wireman was very busily engaged in installing signal wiring such as bells, annunciators, etc., which was much more complex than the electric wiring of today in the ordinary house. He pointed out that in the early days it was necessary for the central station and the wiring contractors to recruit their mechanics from the then existing trades and that some of the best wiremen in central stations in those days had learned the trades of cabinetmaking, carpentry and plumbing.

Mr. Russell brought out the fact that the central-station company manufactured and distributed its product, but that it is utilized in the home and the factory entirely by means of the contractor and his wiremen and for that reason it is his central station. He also stated that during 1922 there were 32,000 old houses wired in Philadelphia and this number is expected to be exceeded during the present year. Mr. Russell suggested that the way in which the stock of the electrical central station was being sold, and with the rate of interest earned, it would not be a bad idea for the contractor and his wiremen to own some of this stock, making it still more his central station.



PARTIAL VIEW OF NEW YORK SIGN SHOW

What Other Companies Are Doing

Jefferson Barracks, Mo. — The new United States Veterans' Hospital at Jefferson Barracks, Mo., to be completed about March 1, 1923, will have a thoroughly modern electrical equipment. A 13,200-volt substation has been provided to supply energy from the Union Electric Light & Power Company of St. Louis. The total lighting load will be about 85 kw. and the connected power load will be approximately 120 hp. In addition to the light and power loads there will be installed electric cooking equipment consisting of the following: Three hotel ranges, 75 kw.; one broiler, 15 kw.; one bake oven, 25 kw.; fourteen domestic ranges (for officers' quarters and nurses), 95 kw.; eight hot plates, 4 kw.; miscellaneous other equipment, 6 kw.; total, 220 kw. The total electric load in the hospital will be approximately 400 kw.

Illinois.—A number of electric range demonstrations have been staged this winter by the Public Service Company of Northern Illinois in its various districts with good results. Special preparations have been made in each case. In addition to advertisements in the local papers, invitations were sent out extensively. The effect was to draw out a good attendance, a great many people driving in from small towns a dozen or more miles distant. A number of sales were made and an active "prospect" list obtained.

Indianapolis, Ind. — Total merchandise sales by the Interstate Public Service Company during 1922 showed an increase of $74,981, or 50.7 per cent over the sales for 1921.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Hydro-Electric Development and Steam Equipment

Control of Corrosion by Deactivation of Water.—F. W. SPELLER.—The study of corrosion is confined particularly to corrosion under water, where the amount of oxygen present is limited to the solubility of that gas in water, and to soil corrosion, in which the ratio of moisture to available oxygen varies considerably. It includes corrosion of interior pipes, tanks, economizers, boilers and other closed water systems which form an important part of building and power-plant construction. The main factors which control the rate and distribution of corrosion of iron in water are amount of oxygen in solution, temperature, quantity and velocity of flow, quality of water and contact with electro-negative material. The author describes some of the protective coatings that have been applied to pipes and that are advantageous to prevent corrosion, giving various methods of de-aërating water and types of apparatus used to remove oxygen.—*Canadian Engineer*, Jan. 9, 1923.

Wind-Driven Electric Power Plant.—R. BOSSELMANN.—A feature of the suggested arrangement is the combined use of a mechanical and an electrical regulator, the former maintaining nearly uniform speed, the latter constant voltage of the driven compound-wound dynamo. Both regulators are described in detail. It is claimed that the plant will operate without any attendance, save an occasional bearing inspection.—*Elektrische Kraftbetriebe und Bahnen*, Dec. 10, 1922.

Vapor-Refrigerating Condensers for Steam Turbines.—F. C. EVANS.—In order to improve the economy of steam turbines by the further reduction of the back pressure, cooler condensing water must be provided or some other cooler condensing substance used. Present-day custom is to produce low temperatures artificially for various refrigerating processes. The author's investigations are along these lines, with the purpose of finding out whether it would be economical from a thermal standpoint to place cooling coils of a refrigerating system in a steam condenser to reduce back pressure on the steam turbine.—*Sibley Journal of Engineering*, December, 1922.

Northwest Station Increasing Stoker Capacity.—Forced-draft chain grates, replacing natural-draft stokers in the Northwest station of the Commonwealth Edison Company, Chicago, have given the increase in the steam supply necessary to meet new demands. Operation normally is at 200 per cent of rating and 300 per cent for boilers during peaks. Ordinary daily range in combustion rate is from 35 lb. to 50 lb. of coal as fired per square foot of grate per hour, with an extreme maximum up to 55 lb. A description of the new stokers is given.—*Power*, Jan. 9, 1923.

Transmission, Substations and Distribution

Automatic and Semi-Automatic Substations for Electric Railways.—C. A. BUTCHER.—A general review of the subject with illustrations to show the sources of savings which result from non-manual switching forms the substance of this paper, presented before the Central Electric Railway Association, Louisville, Ky., Jan. 18. The author points out that full automatic control in general appears preferable.—*Electric Railway Journal*, Jan. 27, 1923.

Influence of a Three-Phase Line Upon a Nearby Low-Voltage Line.—E. NATHER.—The paper describes a mathematical and graphical method of calculating the potential induced in a low-voltage wire carried parallel to a high-voltage three-phase line, for which the author claims greater simplicity than the known purely mathematical methods.—*Elektrotechnik und Maschinenbau*, Dec. 24, 1922.

Reinforced-Concrete Poles.—E. MARÉCHAL.—It is suggested in this paper that reinforced-concrete poles be built from standard pieces made by series manufacture in special shops, these pieces being shipped to the places where the poles are to be erected. Here they can be assembled in a number of different pole types or even used to construct small transforming stations. Formulas are given to calculate the safe section of the concrete beams for different wire pull and tower height. Attractive appearance, long life and cheapness are among the chief advantages claimed for the towers.—*Revue Générale de l'Electricité*, Dec. 23, 1922.

Units, Measurements and Instruments

Short-Circuit-Proof Current Transformers.—C. SCHRADER.—The paper describes in much constructive detail the short-circuit-proof "one-turn" or "bar-type" current instrument transformers. They are being made from 50 amp. to 3,000 amp. in a number of standard sizes, all for a secondary current of 5 amp. As the name implies, these transformers have a primary winding of only one turn, so that short-circuit forces, no matter how large they may be, can result in no destructive action. The secondary turns are arranged around an annular laminated iron core, placed concentrically around the primary bar. The unusually low values of 50, 70, 100 and 150 amp. for this type of measuring transformers are explained as follows: For the operation of relays only, where no accuracy is required, a bar type may be used for as little as 50 amp. For the operation of a single wattmeter as small a type as 200 amp., may be used with sufficient accuracy. For the operation of a watt-hour meter, or all other instruments requiring high accuracy no bar-type transformers smaller than 300 amp. to 500 amp. are recommended. These instrument transformers have been standardized with insulations up to a maximum of 300,000-volt test tension.—*Elektrotechnische Zeitschrift*, Dec. 14, 1922.

Automatic Depth Recorder as an Aid to Navigation.—LIEUT. S. G. LAMB.—An apparatus which determines depth soundings by utilizing the reflection of sound waves from the sea bottom is described. The principle on which the apparatus works is briefly as follows: The time interval between making a sound wave on board ship, such that the wave is transmitted to the water through the skin of the ship, and the reception of the reflected wave from the sea bottom is accurately measured and the depth is calculated from this interval, the velocity of sound in sea water in feet per second having previously been determined.—*United States Naval Institute Proceedings*, January, 1923.

Motors and Control

Electrical Equipment in Large Mail Terminal.—R. G. LOCKETT.—Push-button stop and start, interlocking control and indicator lamps are features of the system of dispatching mail in the Union Station at Chicago, Ill. The author confines his discussion to a description of the electrical equipment of the conveyors, motor and control circuits and control boards.—*Railway Electrical Engineer*, January, 1923.

Power Problems of Rolling Mills.—A. H. DYCKERHOFF.—Oftentimes it is found that motor ratings are seemingly out of proportion with the rolling-mill duties generally practiced and that mills of apparently the same character are driven by motors of different capacity. There are several reasons for such a condition, among which are extraordinary expectations and ambitious tonnage demands and the indefiniteness of the future rolling schedules. These demands cannot be satisfied without certain sacrifices involving high first cost of motor and control, inefficiency, low power factor and inability of line and generator to deliver power. The author stresses the overpowering of mills and the resulting influence of power factor.—*Iron Age*, Jan. 4, 1923.

Synchronizing Motors Under Full Load.—DR. FRAENCKEL.—Synchronous motors, capable of starting under full load, have a polyphase wound rotor with collector rings and brushes leading to the starter. After starting, direct current is applied to the slip rings

and the motor changes its character from straight induction to a synchronous type. The paper contains theoretical and practical data on the exact starting conditions of this type of motor and describes what influence the position of the rotor has upon the starting conditions at the instant of applying the direct current. An automatic synchronizing device is mentioned which closes the direct-current switch at the most suitable instant. Finally an approximation method is given to calculate the smallest excitation for a given motor load. A number of oscillograms are reproduced which show a very close check between the calculated and actually observed values.—*Brown-Boveri Mitteilungen*, December, 1922.

Individual Drive of Milling Machines.—K. MELLER.—Several examples of modern individual motor drives for milling machines are given with the purpose of showing the great advance in the design of such drives made in the last twenty-five years. For large milling machines a multi-motor drive is advocated, so that the cutter is driven by the main motor and the feeding device by a second smaller motor. An electrically operated interlocking mechanism is then required to prevent collisions between the two independent motions. As an example, showing to what an extent such multi-motor drive can be carried out successfully, a photograph of a large milling machine with three motors for cutting and four motors for feeding is shown.—*Siemens Zeitschrift*, December, 1922.

Illumination

Terminal Lighting Development on the New Haven Railroad.—G. F. JOHNSON.—Railroad yard lighting is primarily space lighting, with the following problems injected, namely, the presence of deteriorating gases, movable cars causing shadows, lack of clearance between tracks to place poles, the prevention of glare that will interfere with the operation of the trains through or near the yards and the interference of the overhead propulsion current wires. Improved illumination in several of the yards on this road is the result of much study and experiment and is briefly discussed.—*Railway Electric Engineer*, January, 1923.

Heat Applications and Material Handling

Coal-Handling Plant.—M. DRUEY.—The paper describes a coal handling and conveying crane for a French mine which is unusual on account of its size. It consists of a double-portal traveling crane with a combined span of 523 ft., made up of two symmetrical halves with a span of 261 ft. each. Each half is independent of the other and has a traveling clamshell bucket of 5 tons capacity (including weight of bucket). Double rope drive is used for closing and opening the bucket. For the three motions three motors of 34, 28 and 445 hp. are provided, all for direct current and 250 volts. A special low-speed drive permits an exact stop of the large structure at any desired point. A locking device prevents the crane with its large surface from being moved by wind. A complete wiring diagram of the crane is given.—*Bulletin Oerlikon*, November, 1922.

Electric Steel Industry After Ten Years.—E. F. CONE.—No marked increase in capacity and no outstanding developments marked the progress of the American electric steel industry during 1922, according to the tenth yearly review made by the author on this subject. The number of new installations registered during the last year is the smallest in the history of the industry. A tabulated review shows that the total number of installations has expanded in ten years to 407 furnaces. This table, which is included in the original article, shows where each furnace is installed, its number and size, make, and the product made.—*Iron Age*, Jan. 4, 1923.

Traction

Investigation of the Properties of Chilled-Iron Car Wheels.—J. M. SNODGRASS and F. H. GULDNER.—This bulletin presents two additional phases of the investigation of the properties of chilled-iron car wheels conducted at the University of Illinois. The investigation had for its object the determination of the strain which may occur within a car wheel and the limitation of present designs with the view of improving the chilled-iron car wheel and making it more satisfactory under present and future service requirements. The first part of the bulletin contains a report of an extension of the tests previously reported in Bulletin No. 129 and discusses the strains existing in a 33-in., 840-lb. arch plate wheel when subjected to the combined effect of mounting, static load and side-thrust pressures. The remainder of the bulletin deals with a series of tests made to determine the ultimate strength of the car-wheel flange.—*Bulletin No. 134 of the Engineering Experiment Station, University of Illinois.*

The Sydney Tramway System.—This system is owned and operated by the New South Wales government and last year carried nearly a million passengers a day. The traffic problems include street congestion in the business district and transportation of large crowds to races and other various popular outdoor events in Sydney.—*Electric Railway Journal*, Jan. 13, 1923.

Distribution for Direct-Current Railway Service.—E. SORELLI.—The system consists of centralizing the distribution of electrical energy by feeding the lines with machines installed in one unique substation and supplying two different tensions. The lower tension (about 1,200 volts) is directly connected from the substation to the contact wire, and the higher one (about 1,600 volts) from the same substation to the end of each line. The distance covered by each line is about 20 miles. This would compensate the losses all along the lines and maintain the voltage practically constant. This system has had a practical application in Italy and has worked out very satisfactorily.—*Elettrotecnica*, Nov. 5, 1922.

Telegraphy, Telephony, Radio and Signals

Loaded Long-Distance Cables in Europe.—P. E. ERIKSON.—The author outlines briefly some of the achievements in the field of long-distance cable telephony in Europe. When the demands of additional circuits arose several of the progressive telephone administrations in Europe turned their attention to the paper-insulated long-distance cable. The countries which first gave this question serious consideration were Great Britain, Holland, Italy, Sweden and Switzerland. The results obtained by each of these countries are described.—*Electrical Communications*, Vol. 1, No. 2.

Standardization of Inductors at Radio Frequencies.—The method of measuring the apparent inductance at any radio frequency of a fixed or variable inductor is described. The apparatus consists of a variable condenser, a wavemeter standardized in terms of frequency or wave length, a thermo element and galvanometer, a current square meter, several non-inductive resistors of known resistance and a source of undamped, unmodulated waves. The observations consist of the readings necessary for standardization in terms of frequency or wave length of the circuit composed of the standardized condenser, the inductor to be measured and connecting leads spaced well apart and as short as is possible without bringing the coil to within about 10 cm. of the condenser. A limited supply of this letter circular is available to persons who have actual use for.—*Letter Circular No. 76 of the Bureau of Standards.*

Miscellaneous

Bibliography and Patents on Electrical Insulating Material.—In connection with the Bureau of Standards investigation of the properties of certain types of electrical insulating materials, a rather comprehensive bibliography of papers, books and periodicals has been prepared. An examination of the United States patents covering insulating materials and method of manufacture, and particularly materials of the phenolic type, has also been made. Since a considerable demand has arisen for copies of these, they have been issued in mimeographed form as Letter Circular No. 50, "Bibliography of Books and Titles of Periodicals on Properties and Uses of Insulating Materials," and Letter Circular No. 51, "Lists of the More Important United States Patents Covering the Materials and Methods of Manufacture of an Insulating Material." A copy of either will be sent on request to any persons who can show an actual need for them as long as the limited supply lasts.—*Letter Circulars Nos. 50 and 51 of the Bureau of Standards.*

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Pact Waits on Arizona

Still Hope She Will Accept Colorado River Treaty Without Reservations—Colorado Will Follow

TELEGRAPHIC advices from Phoenix received in Washington as the ELECTRICAL WORLD closes its forms are to the effect that Arizona will ratify the Colorado River compact without nullifying reservations. Sentiment has changed decidedly during the last few days as the pressure of public opinion has become more and more felt, and it seems certain that a majority of the members of the Arizona Senate will vote for ratification rather than assume responsibility for the defeat of the ratification bill now before them, which would have the effect of delaying indefinitely any important development of the river. It is also stated that the Senate will eliminate the three reservations which the House committee has proposed, even if the House should pass the bill with those reservations intact.

Since it is believed very generally that Colorado, the only other state of the seven affected which has not ratified, will act quickly once it is assured that Arizona will ratify, there still is a chance for the sitting Congress at Washington to ratify the compact and put it into effect.

THE PROPOSED RESERVATIONS

The reservations proposed by the committee of the Arizona House of Representatives provide for the payment of $5 per horsepower-year on all power generated in Arizona, that Mexico's rights to water be restricted to 2,000,000 acre-feet, and that the Gila River be eliminated from consideration. It is very evident that any ratification with reservations is tantamount to no ratification. It is contended by those interested in the development of the river that no effort should be made in this indirect manner to interfere with ratification. It is believed that the reservations themselves are the outcome of misunderstanding. The state can place the $5 royalty tax at any time, and it is apparent that it should be carried in a separate bill; nor is it within the jurisdiction of a state to suggest what the federal government shall do in a matter of international relationships, while to eliminate the Gila is entirely contrary to the spirit of the compact—Colorado would have just as much right to adopt a reservation eliminating the Grand.

The opposition in Arizona to ratification has come from three groups. The principal opposition has been from those misunderstanding the results that the adoption of the compact would bring. It is this group that now has been largely won over to ratification. A second group apparently is actuated by selfish political motives. The third group is that which favors municipal ownership.

Electricity, Again Blamed for Fire, Again Acquitted

Twenty-seven inmates and attendants lost their lives in a fire which broke out last Sunday in an asylum for the insane on Ward's Island, in the East River at New York City, and Monday's newspapers attributed the blame to "uninsulated wires." Wednesday morning's papers, however, contained the tardy assertion that the official investigators had "united in eliminating electrical wiring as the cause of the fire," which was the second in two weeks. The chief electrician testified that all the lamps in use in the building were burning after the fire started.

President Harding Approves Reorganization Plan

The joint congressional committee on reorganization of the government departments has received from President Harding an outline of the reorganization plan recommended by the President and the Cabinet. The outstanding recommendations are as follows:

1. The co-ordination of the military and naval establishments under a single Cabinet officer as the Department of National Defense.

2. The transfer of all non-military functions from the War and Navy Departments to civilian departments, chiefly Interior and Commerce.

3. The elimination of all non-fiscal functions from the Treasury Department.

4. The establishment of one new department, the Department of Education and Welfare.

5. The change of the name of the Post Office Department to Department of Communications.

6. The attachment to the several departments of all independent establishments except those which perform quasi-judiciai functions or act as service agencies for all departments.

These general proposals are followed by a detailed list of suggested changes and transfers in the respective departments as now constituted. It is highly improbable that any bill founded on these recommendations can be reported to the present Congress, which expires on March 4.

Three Utility Bills Now In

The New York Administration Aims to Abolish the Present Commission and Aid Public Ownership

THREE bills embodying the plans of the state administration for utility control were introduced into the New York Legislature on Monday of this week. One of them legislates the present Public Service Commission, composed of five members with terms of ten years, out of office and creates a new commission, composed of three members to serve for six years. This measure abolishes the law passed during Governor Miller's administration whereby the commission was authorized to increase or reduce a rate of fare or charge by a public utility fixed by franchise agreement. It also strikes out the authority of the commission to establish temporary rates pending a hearing requested by a utility.

There is some question as to whether the object of this measure, to restore former contract rates, has been accomplished, since the legislation of 1921, by implication, abrogated all existing contracts and repealed all special and general laws and since the measure now presented has failed specifically to mention such abrogated contracts or to re-enact any statute that might have been so repealed.

MUNICIPAL OWNERSHIP FAVORED

Under one of the two other bills, an amendment to the general city law, all municipalities throughout the state are endowed with the broadest powers to "own, establish, construct, acquire and operate" public utilites of all kinds. The Board of Estimate in New York City and the common councils of other cities, with the consent of the Mayor, under the terms of this bill would determine the policy of their respective municipalities. There is no provision for a popular referendum.

Existing utilities "or any part thereof" may be acquired by condemnation and the necessary expenditure involved met either by taxation or through a bond issue. The bill does not affect transit facilities in New York City already provided for in Mayor Hylan's transportation bill, but it relates to all other classes of public utilities in the city.

The third bill eliminates from the Public Service Commission law all references to the New York City Transit Commission, which is to be abolished, and makes the law conform in other respects to the New York City transportation bill now pending.

Lessons of Eagle Rock Fire

Need for Care in Placing 60,000-Volt, Oil-Filled Lightning Arresters—How Service Was Restored

THE disastrous fire which occurred at the Eagle Rock substation of the Southern California Edison Company on the evening of Jan. 8 owing to the explosion of a 60,000-volt oil-filled lightning arrester indicates that considerable care must be used in installing such arresters. It is probable that if in this case the arresters of this type had been placed exterior to the substation or if arresters which contained no oil had been used much of the damage would have been avoided.

The fire started at 9 o'clock in the evening, when a set of 60,000-volt aluminum-cell lightning arresters blew up. It is thought that there was a short circuit on one of the lines, but it is not known whether there was an external short or whether the failure of the arrester itself was the short. When the arrester blew up it spilled burning oil in all directions throughout the 60,000-volt lightning-arrester room. This caused the other arresters to become overheated, and they in turn boiled their oil out, which resulted in a more intense fire. It is also probable that some of the arrester tanks overturned. The fire burned out the windows between the 60,000-volt arrester room and the riser wells of the transformers and lines, and the smoke from this burning oil went to the fourth and fifth floors of the substation building, collected around the 150,000-volt bus and burned under the ceilings of these floors.

The 150,000-volt arresters were in a gallery above the 60,000-volt arresters. There were windows between this gallery and the riser wells as well as behind the 150,000-volt arresters. These windows burned out, and the heat, which was very intense, set the arresters on fire or caused them to blow up. The two 150,000-volt buses were damaged to such an extent that it was necessary to replace most of the porcelain insulators, porcelain disconnecting switch supports and parts of the bushings of the 150,000-volt switches. None of the major equipment in the substation, such as the transformers and synchronous condensers, was damaged. The control board was also uninjured. The transmission line to the substation was left in first-class condition. The section of damaged 150,000-volt bus between the transmission line and the transformers was the chief loss. The total damage will probably not exceed $100,000, which is considerably less than the half million first reported.

How Service Was Restored

To restore service the Big Creek power-house transformer connections on the high-tension side were changed from 150,000 volts Y, with grounded neutral, to approximately 80,000 volts delta. At Eagle Rock the transmission line was disconnected from the bus, a few temporary poles were set and Big Creek was fed directly into the 60,000-volt system just outside of Eagle Rock substation, thus supplying Southern California. The only crippling of service was on the 15,000-volt railway supply at the time of the morning peak on the next day, and this condition was remedied within a few hours.

It was found that "foamite" was of considerable value in fighting an oil fire, and steps are being taken to install such fire-fighting equipment in all of the principal stations on the system. At present the station is operating under normal conditions on the Big Creek line, with one 150,000-volt bus at Eagle Rock in first-class condition. It was necessary to use the delta, 80,000-volt connection at Big Creek for only about five days before Eagle Rock was sufficiently repaired to permit of 150,000-volt grounded Y operation on the Big Creek line. Fortunately none of the 220,000-volt auto-transformers or other 220,000-volt equipment in the process of installation at Eagle Rock was damaged.

Public Relations Main Theme at Albuquerque Meeting

Better public relations was the theme that dominated the ninth annual convention of the New Mexico Electrical Association, held on Feb. 12 and 13. While there were a large number of papers and addresses dealing with the technical and business sides of the public service industry, it was noticeable that even these were tinged with one thing or another concerning the building of public good will.

The convention was held in Albuquerque and the attendance was the largest in the history of the association. The manufacturers, jobbers and dealers, as well as the central-station companies, were largely represented, delegates coming from as far east as Chicago, as far south as El Paso, as far west as San Francisco and as far north as Denver. As a result of the discussions growing out of the various addresses and papers on public relations, this phase of the public utility industry will receive the attention of all of the universities in New Mexico.

Those who delivered addresses or read papers were: B. C. J. Wheatlake, General Electric Company, Denver; J. E. Moorhead, Mountain States Telephone & Telegraph Company, Denver; C. A. Winder, Southwest General Electric Company, El Paso; Dr. John D. Clark, State University of New Mexico; George E. Lewis, executive manager Rocky Mountain Committee on Public Utility Information, Denver; Prof. R. W. Goddard, State College of New Mexico; J. F. Dostal, Colorado Springs Light, Heat & Power Company, and M. Nash, an electrical contractor of Albuquerque.

E. A. Bradner of the Las Vegas Light & Power Company, Las Vegas, was elected president of the association, to succeed D. E. Bent of the Tucumcari Light & Power Company. Charles E. Twogood of the Albuquerque Light & Power Company was re-elected secretary.

News from the Capital

Radio Bill Doomed in Senate—Ford Bill Not Reported Out—High Dam License Waits on Minnesota

FROM the Washington bureau of the ELECTRICAL WORLD news comes that the radio bill is dead. The Senate committee on interstate commerce has decided definitely to take no action on the measure which already has passed the House of Representatives. Senator Underwood, the Democratic leader, takes the position that the bill is too important and too far-reaching to be rushed through in the closing days of Congress, when it is impossible to scrutinize it carefully and to conduct the public hearings which he deems necessary.

The failure of this legislation, along with the legal decision which has overthrown the present methods of restraint, leaves radio communication practically uncontrolled. Secretary Hoover says that he will search for authority to follow a temporary policy, but he is doubtful whether those concerned would undertake the necessary new instrumentation which would have to accompany a change of wave lengths, when there could be no guarantee as to the permanency of the new plan.

Ford Bill Not Reported

By a vote of six to thirteen the House rules committee refused on Monday to report out a resolution giving Henry Ford's offer for Muscle Shoals right of way in the House. This precludes consideration of Muscle Shoals legislation at this session unless a majority of the House votes to override the rules committee.

Status of High Dam

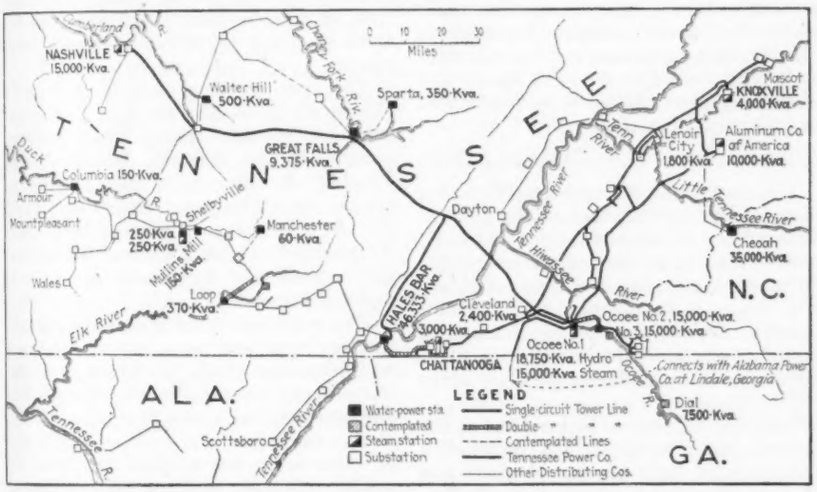
Advices received at Washington from St. Paul are to the effect that the Minnesota Legislature is not likely to adopt the bill authorizing the Municipal Electrical Corporation or the city of Minneapolis, or both, to issue bonds to put in the power project at the High Dam on the Mississippi. Apparently a majority of the members of the Legislature feel that the placing of a power business which would amount to $1,000,000 a year at the disposition of a city council which changes each two years would not make for economical operation and would result in costly power.

The Federal Power Commission will not act in this matter until the Legislature takes definite action or adjourns without having taken action. It will then determine promptly, it is believed, who shall have the license. It will apparently be a question of determining whether it shall go to the Northern States Power Company or to Henry Ford, and there is a very generally held opinion that the license will go to the Northern States Power Company, as the water-power act places the use of power sites for public utility purposes above their use for private industries and this policy has won the favor of the Federal Power Commission in previous cases of similar character.

Electrical Progress in Tennessee

Expansion Program of Tennessee Electric Power Company Includes Additions at Nashville, Chattanooga, Great Falls and Other Places—Selecting Site for New Steam Plant

LOAD is increasing so rapidly on the system of the Tennessee Electric Power Company that it has already ordered a 12,500-kva. turbo-generator for the steam plant at Nashville to bring its rating up to 27,500 kva. and is contemplating other additions. Among the company's problems are the best method of increasing the 10,000-kva. hydro-electric development at Great Falls, on the Chaney Fork River, and the best location for a new steam station probably of 15,000 kva. to 20,000 kva. rating. The installation of switches are to be installed during February or March at Parksville, and some of the high-tension switches are being modified to give better rupturing performance. Among the chief changes being considered are stronger tanks, heads and tie rods on some switches, mufflers and explosion chambers on others and new bushings on still others. Since some of the switches are not adapted to bushing-type current transformers, an oil-immersed shunt has been devised for activating the tripping circuit.



TENNESSEE SYSTEMS MERGED INTO THE TENNESSEE ELECTRIC POWER COMPANY

a 7,500-kva. synchronous condenser at Chattanooga to improve voltage regulation is another project. A 120,000-volt circuit will be built from Cleveland to Knoxville, giving duplicate service at 120 kw. At Great Falls there is the opportunity of increasing the head 30 ft. to 35 ft. and thereby improving the chance to add a 15,000-kva. waterwheel generator, making a total of 25,000 kva.

Three sites for a steam plant are being considered, near Hales Bar, or at Chattanooga on the Tennessee River, or at Knoxville. The most advantageous point would be at Hales Bar, because plenty of condensing water would be available, coal could be transported by barge, and besides the plant would back up the Hales Bar hydro-electric plant during the dry season and during high backwater. Furthermore, no new transmission line would be needed.

Other water-power sites remain to be developed on the Ocoee River, but from an economical standpoint they remain in the future. Additional power facilities are also expected after the completion of the 110,000-volt line which the Georgia Railway & Power Company contemplates from Lindale, Ga., to the Tennessee-Georgia state line to connect with a line to Chattanooga.

Switching facilities are being improved. Entirely new low-tension

About eighty thousand insulators are being replaced by others of the same make but of a more modern type. To determine which shall be changed the "buzz stick" method is being used and the insulators are being changed with the circuits "alive."

Between Cleveland and Copper Hill, where no telephone lines exist, carrier-current communication will be utilized.

European Engineers Take Note of Joint Committee

At a meeting of the executive committee of the Joint Committee for Business Development held in New York on Feb. 15 it was announced that requests had been received from nearly thirty cities asking assistance in the formation of local leagues or clubs.

Messrs. Lane, Marshall and Goodwin were appointed a committee to prepare a display for the Joint Committee at the N. E. L. A. convention in June.

William L. Goodwin of the Society for Electrical Development reported that the society's first monograph, "Building Residence Lighting Business," would be completed about the middle of March. "Useful Information for Architects and Builders," he said, will be ready in April, and other booklets are being prepared. These include "Customers Versus Population," "Advertising Service for Electric Homes," and "Organizing and Conducting an Electric League."

A. K. Baylor, chairman of the wiring department, reported that he had prepared a paper on wiring for the General Engineering & Management Corporation and that it had been sent to all the officers of that organization. The booklet being prepared by the heating and melting department, of which C. K. Nichols is chairman, will soon be ready.

S. E. Doane of the National Lamp Works of the General Electric Company spoke of the conditions in the European electrical industry which he studied during his recent trip abroad. He said that he had heard of the work of the Joint Committee as far east as Hungary, and that the European engineers were amazed at what had been accomplished in this country. He predicted that before long foreign countries will send electrical missions here to study our methods.

Alabama Utilities Must Open Their Books

Public utilities in Alabama must open their books to the Public Service Commission of the state at any time that body requires, under a bill just signed by the Governor. Any person appearing for the public in a valuation case may apply for a rehearing and appeal to the courts from any decision of the commission. Heretofore only the company could apply for a rehearing or appeal from the commission's ruling.

The law is a result of the contention by the Alabama Power Company and the Mobile Gas Company that the commission had no right to grant a rehearing after a tentative valuation had been fixed. Both companies declined to submit books on the ground that no cases requiring such inspection were pending.

Los Angeles A. I. E. E. Hears About Ceramics

Before the February meeting of the Los Angeles Section of the American Institute of Electrical Engineers, Frank H. Riddle, president of the American Ceramic Society, and Dr. J. A. Jeffery, president of the Champion Porcelain Company, read papers, Mr. Riddle dealing entirely with ceramic development of porcelain insulators and Dr. Jeffery discussing modern methods of firing high-voltage porcelain. Both speakers referred to the discovery of silaumite, which Dr. Jeffery stated eventually would replace the clay now imported from England in forming the principal body for porcelain. Silaumite, he said, is mined at the present time exclusively in California and it is found within 50 miles of Bishop. So far as known, there is no other place in the United States where this mineral is to be found. At least this is the only commercial deposit of which there is now any knowl-

edge. Mr. Riddle said his companies had 500,000 lb. of silaumite in Detroit at the present time for porcelain making. This mineral, though discovered only two years ago, is revolutionizing porcelain for long-distance transmission purposes, he declared.

"As mined at present," said Mr. Riddle, "many difficulties are met with. It is brought to the railroad by burros and then shipped to Detroit. The present supply is adequate and there is a strong possibility in the not distant future of building a plant of large proportions on the Pacific Coast. Before any such step is undertaken, however, more experimental work must be prosecuted. We are still developing an electrical fire kiln to carry loads twenty-four hours."

Both speakers asserted that the Pacific Coast buys in one year in insulators approximately what the rest of the United States buys in two years.

To Improve Lighting of Post Offices

Expert Investigation Carried Out Under Federal Direction Brings Recommendations for Standard System All Over Country Insuring 10 Foot-Candles on Working Plane

ESTABLISHMENT of a standard system of lighting in all post offices has been strongly recommended in a report just submitted to the Post Office Department by the Office of Industrial Hygiene and Sanitation of the United States Public Health Service. This report, the result of an elaborate survey conducted at the special request of Postmaster-General Work, maintains that millions of dollars will be saved through increased speed in the work of postal employees provided that a complete change is effected in the illumination of workrooms of post offices throughout the country.

Virtually all the work performed in post offices with the exception of that of laborers depends primarily upon the use of the eyes, making the question of illumination of paramount importance in decreasing or increasing its rapidity and accuracy. Conducting a thorough and technical study of lighting over a long period of time at two representative post offices, one modern and the other of the old type, the experts observed almost five thousand postal workers employed constantly in handling the mails both under artificial and natural light.

They found that illumination in many post offices was low in intensity and unsatisfactory in quality. In some instances it fell below the requirements provided by the state code of laws and below the artificial light furnished employees in private industries doing similar work. A study of the relationship between the volume of illumination and the strain on the eyes of workers revealed the fact that there were more eye defects among employees working under the average illumination of 2 to 3 foot-candles in the old post office than under the 3 to 4 foot-candles in the new post office. Sorting and separating mail in the basements of post office buildings was especially discountenanced except in extreme emergencies.

Speed Increases 4.4 per Cent

In the speed and accuracy tests it was found that for the letter separators there was an average increase in speed, or decrease in the times of separation, of at least 4.4 per cent when going from 3.6 to 8 foot-candles. Assuming that the same relative increase of speed would prevail in all the divisions of the post office where these tests were made under the same relative increase in illumination, an annual net saving, after deducting increased cost for lamps and energy, of about $109,000 was indicated in this post office alone.

Intensity of 10 Foot-Candles Needed

The investigations recommended that there should be installed in the general workrooms and offices systems of totally inclosing units of the diffusing or light-directing type, giving a general intensity when first installed of 10 foot-candles everywhere on a horizontal working plane 45 in. above the floor. All local lighting should be done away with.

The lighting unit to be installed in the general workrooms of the post office should be of such quality of glass and of such shape and size that its surface brightness at any point would not exceed 2.5 cp. per square inch when used with an incandescent lamp or other source of light emitting 3,100 lumens. This unit should have an output of at least 80 per cent of that of the clear lamp and a spherical distribution of its candlepower such that at least 8 per cent of the light emitted by the clear lamp would be emitted by the unit through the zone from 0 deg. to 30 deg., at least 28 per cent from 0 deg. to 60 deg., at least 48 per cent from 0 deg. to 90 deg., and at least 25 per cent from 90 deg, to 180 deg.

The lighting unit for the offices of the post office should be of such quality of glass and of such shape and size that its surface brightness at any point would not exceed 2 cp. per square inch when used with an incandescent lamp or other source of light emitting 3,100 lumens. This unit should have an output of at least 80 per cent of that of the clear lamp and a spherical distribution of its candlepower such that at least 8 per cent of the light emitted by the clear lamp would be emitted by the unit through the zone from 0 deg. to 30 deg., at least 23 per cent from 0 deg. to 60 deg., at least 43 per cent from 0 deg. to 90 deg., and at least 35 per cent from 90 deg. to 180 deg.

Both the units for the general workrooms and the offices should be such in number and so spaced that the brightness of the units measured in lumens per square foot would not be more than one hundred times as great as the intensity of the illumination, measured in foot-candles, produced by them on a horizontal plane 45 in. above the floor.

Recommendations on the care of the lighting system and a disquisition on modern methods of illumination are included in the report.

Solidarity Theme of Pacific Coast Supply Jobbers

The quarterly meeting of the Pacific Division of the Electrical Supply Jobbers' Association, held at Del Monte, Cal., Feb. 8-10, was the largest which the records of the association show. The sessions were in charge of Chairman C. E. Wiggin, and, besides the jobbers, an unusually large registration of manufacturers and representatives of other electrical interests took place.

The open meeting of Feb. 10 was in charge of E. O. Shreve, San Francisco manager of the General Electric Company. R. A. Balzari, Westinghouse Electric & Manufacturing Company, spoke on "Business Courtesy," and W. R. Alberger, vice-president San Francisco-Oakland Terminal Railways, dealt with the problems of electric railway business.

The principal discussion of the meeting centered around a chart, designed and presented by E. O. Shreve, describing a proposed co-ordination of the different electrical clubs, leagues and societies to promote a greater solidarity of interest in the mutual problems of public utilities, with particular reference to their bearing upon the electrical industry.

Oklahoma Gas & Electric Is Friend in Need

Fire on Saturday afternoon, Feb. 10, completely destroyed the electric light plant of the Minnesota Light & Power Company at Cushing, Okla. As soon as the seriousness of the blaze was seen the Mayor of Cushing called up J. F. Owens, vice-president and general manager of the Oklahoma Gas & Electric Company, at Oklahoma City, and asked for aid in restoring service. Response was instant, and superintendents and crews of the Oklahoma Gas & Electric Company were rushed to Cushing from various division headquarters. Emergency lines were strung to the circuit of the Shaffer Oil & Refining Company, just outside of Cushing, which is served from the Oklahoma company's transmission line. As a result, Cushing suffered little inconvenience from the loss of the plant. Storekeepers were able to transact their usual Saturday night business, and even residential districts were in part supplied with lighting.

Much appreciation of this prompt assistance has been expressed in Cushing, whose people would without it have probably had to wait months for the resumption of electrical service.

University of Minnesota's Claim on High Dam

The claim of the University of Minnesota to 15 per cent of all power that may be developed at the High Dam, built by the federal government across the Mississippi between Minneapolis and St. Paul, has been already referred to in the ELECTRICAL WORLD. This claim is supported by a resolution passed by the regents of the university at the instance of Governor Preus of that state. The Governor's stand is based on the agreement entered into when the dam was begun. A corporation of three members was then formed—the Mayors of Minneapolis and St. Paul and the chairman of the board of regents of the University of Minnesota. The general understanding was that the three corporations, two municipal and one educational, were entitled to share the power equally.

The city of St. Paul favors turning the power over to Ford. Minneapolis business men also favor that policy, although the city administration does not. Both groups ignored the probable attitude of the University of Minnesota until Governor Preus came forward with the resolution showing that had it not been for university expert advice the dam never would have been built at a point making the development of water power available. Furthermore, the resolution says, the University of Minnesota is co-operating with the federal government in many experiments requiring power and is the only state university situated close to power that is still under the government's control.

The power available at the high dam will range from 2,500 kw. to 10,000 kw. according to the time of year and has been estimated by electrical engineers at 18,000,000 kw.-hr. a year. Supporters of the Ford plan have maintained that the university could not use more than 1 per cent of the power and that Ford plans erection of a large electrical experiment plant at the dam and is willing to give faculty and students the use of this plant.

The university regents have authorized architects to go ahead with plans for a new electrical engineering building to cost $300,000, and it is planned to begin work in the spring. The university is also just completing a large and finely equipped mines experiment and ore-testing station, and much electrical power will be required for its operation.

Million-Volt Laboratory to Be Finished by March

Construction work on the high-voltage laboratory at the California Institute of Technology is progressing rapidly, and it is expected that the building will be completed by the first of March. The laboratory will be used jointly by the institute and the Southern California Edison Company.

In the laboratory will be installed a million-volt transformer to permit electrical engineers to obtain high voltages for experimental purposes. The Edison company engineers plan to conduct high-voltage tests in connection with their work in transmission. Dr. Robert A. Millikan will use the high voltage in his work on the constitution of atoms.

The million-volt transformer is one designed by Prof. R. W. Sorensen of the institute and will be in four units. In addition to the transformer there will be Poulsen arc equipment, which will be used to obtain high voltages at high frequencies.

New U. S. Army Dredges to Be Completely Electrified

An illustration of the growing tendency to use electricity on shipboard is provided by the four hopper dredges designed by the United States Engineer Corps and being built by the Sun Shipbuilding Company, Chester, Pa. Electricity will propel these ships and steer them, operate the dredging pumps and all auxiliary machinery, supply heat in winter, cool breezes in summer and ventilation at all times, furnish hot water and do the cooking. There will be no fires of any kind.

The main engines of each dredge will be three 1,000-boiler-hp. McIntosh & Seymour Diesel engines, each of which will be directly connected to a 700-kw., 500-volt direct-current generator of 150 r.p.m. These generators will furnish the power for operating the propellers and the dredging pump. Each dredge is to be propelled by twin screws, and each propeller is to be directly connected to an 800-hp., 480-volt direct-current motor of the double-armature type. The speed of these motors can be varied from 90 to 110 r.p.m. The main dredge pump is to be driven by a 750-hp., 480-volt direct-current motor which has a speed variation of from 135 to 160 r.p.m. The windings of both generators and motors will be impregnated with moisture-resisting compounds and inclosed by protecting covers. Forced ventilation will be provided by small motor-driven blowers. Among the motor-driven auxiliary machines on each dredge are twenty-five auxiliary pumps, two air compressors, the steering gear, a windlass, two capstans, two winches, two hopper-door openers, the ladder hoist and the refrigerating machine. The control of almost all of these motors is to be of the automatic type.

Included in the electrical equipment of each dredge are to be eighty-eight electric room heaters, ranging from 1,000 watts to 5,000 watts each in capacity, three 5,000-watt water heaters for each hot-water boiler, twenty-three electric fans and two electric ranges of 22-kw. rating each. The auxiliaries will be supplied with current from two auxiliary Diesel-engine-driven 150-kw., 250-volt generators and also from a 150-hp. motor-generator set which can be supplied with power from the generator operating the dredge-pump motor.

All of the electrical equipment on these dredges is being supplied by the Westinghouse Electric & Manufacturing Company.

N. E. L. A. Appoints Convention Committees

Announcement has been made at the headquarters of the National Electric Light Association of the appointment of the following chairmen of sub-committees in connection with the annual convention in New York City next June: Inspection trips, Philip Torchio; preparation, printing and delivery of entertainment programs, Clarence L. Law; golf, H. M. Edwards; theaters, William J. Clark; local transportation, Col. J. Stillwell. Godfrey N. Atkins will be master of transportation. The hotel committee, it is reported, has its work well in hand.

Northern States Power Is Spending $5,000,000

As part of its recently announced eighty-million-dollar ten-year hydro and steam power construction and development plan, the Northern States Power Company will soon start work on a new terminal substation in Minneapolis to serve the downtown and northwestern sections of that city. The new substation, together with connecting and necessary distributing lines, will cost approximately $1,000,000.

In addition to this, foundations are ready at the Riverside station of the company in Minneapolis for installation of three new 1,360-hp. boilers which have been ordered and are expected to be in operation this year. The cost will be about $500,000. Work also is under way to increase the coal and ash handling capacity of the Riverside station.

A 4,000-hp. steam turbine has been ordered for the Fargo (N. D.) plant of the Union Light, Heat & Power Company division of the Northern States Power Company. This, with the necessary additional boiler capacity, will cost approximately $300,000. It is expected that the installation will be completed next fall.

Total construction now under way at the Northern States Power properties amounts to about $5,000,000.

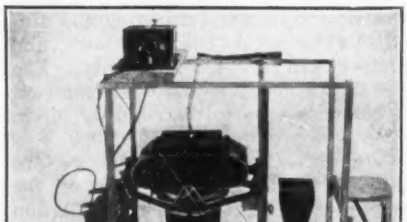
Purchase of Utilities at Montgomery Approved

Formal approval of the purchase by the Alabama Power Company of the properties of the Montgomery Light & Traction Company, the Montgomery Light & Water Power Company, the Alabama Traction Company, the People's Ice & Electric Company and the Power Transmission Company, all of Montgomery, Ala., was contained in an order issued last week by the Alabama Public Service Commission. The purchase price is $6,200,000, but this price, the commission sets out, is not to affect any value which the commission may place on the properties for rate-making purposes. In addition to approving the purchase of the Montgomery utilities the commission also granted the power company's petition for authority to sell $4,000,000 worth of bonds,

the proceeds to be used in improvements and extensions by the power company and to meet outstanding obligations. Both the Montgomery Light & Water Power Company and the Montgomery Light & Traction Company are to be taken out of the hands of the receiver immediately.

Hydro-Electric Survey by Airplane in South

The Alabama Power Company is preparing to survey the section of Alabama through which the Tallapoosa River flows by means of the airplane photographic method. The work of surveying will begin about the middle of March. The plane which will be used is a Breguet bombing type biplane, carrying five passengers, a pilot and 600 lb. of equipment. It is driven by a 300-hp., twelve-cylinder V-type Renault motor, which gives a maximum flying speed of 135 miles per hour, and is the same type of ship that is now



CAMERA USED FOR TOPOGRAPHICAL SURVEY WITH VIEW TO POWER DEVELOPMENT

used in the London-Paris passenger service.

The company plans to use a camera of the Eastman K-1 type, with a single focal lens of 10 in., a 12-in. mapping cone, Venturi vacuum tube, power battery, speed-control unit and view finder. This camera will be mounted over an aperture in the cockpit of the plane on a special vibrationless support and contain a film 75 ft. long, sufficient for 100 exposures. In order to obtain photographs on the desired scale of 800 ft. to the inch, it will be necessary for the plane to fly at an altitude of approximately 9,600 ft. above the area to be photographed.

The result will be a map free from the blunders common to ordinary maps and showing a wealth of detail which it would not be possible to obtain by land surveying except at a prohibitive cost. Only sixty to seventy-five actual hours of flying are estimated to be necessary to complete the work, though two weeks to four months may be required, depending on weather conditions. The company estimates that it would take a land surveying company at least eighteen months to do the same work if that force were no larger than the one to be employed for the air survey, which will consist of about seventy office and field men. A saving of about 50 per cent is expected.

Brief News Notes

A Big Doherty Project.—A permit granted by the Federal Power Commission to the Empire District Electric Company of Joplin, a Doherty property, foreshadows a 60,000-hp. hydro-electric project at Table Rock, near Branson, on the White River, where a great reservoir will be formed. The projected plant will be complementary to the one installed at Powersite, Taney County, ten years ago.

Hagerstown May Sell Light, but Not Power.—Thirteen taxpayers of Hagerstown, Md., who instituted injunction proceedings to restrain city officials from building a new municipal electric plant at a cost of $300,000 because the officials failed first to secure consent of the Maryland Public Service Commission, have obtained a court ruling that the city officials had no authority to erect a plant to generate electricity and sell it for power purposes, although they had the right to manufacture and sell electricity for lighting purposes. The city will carry its contention to the Maryland Court of Appeals.

Bonds for Kahokia Plant Authorized.—The Illinois Commerce Commission has granted the East St. Louis Light & Power Company authority to issue $11,000,000 5 per cent bonds to be used in the acquisition of the Kahokia Power Company plant, now under construction at East St. Louis. The project also embraces acquisition of the properties of the East St. Louis & Suburban Company and the East St. Louis Railway. The corporate name of the East St. Louis Light & Power Company is to be changed to the Union Electric Light & Power Company of Illinois.

Power Merger of Arizona Plants.—The Southern Arizona Power Company has been organized with a capital of $1,500,000 for the purpose of taking over the Nogales Electric Light & Power Company and the Arizona Gas & Electric Company, both of which operate plants at Nogales, Ariz. Prominent capitalists of Los Angeles and southern California are financing the new corporation. A large sum, it is reported, will be expended in extensions and betterments of the existing plants. Eventually power may be brought from northern Arizona to supply Nogales and the mining and other industries in its neighborhood.

An Electrical Department in Builders and Architects' Journal.—The Joint Committee for Business Development has made arrangements with the *American Builder Magazine*, Chicago, for a department in that publication, beginning with the March issue, devoted to electrification of all buildings. The *American Builder* is a handbook for those who plan and build and has a circulation of 55,000 copies a month, going to builders and architects in all parts of the United States and Canada. The new department in this newspaper will describe the complete electrification of twelve model homes with wiring layouts, lighting-fixture arrangements, use of appliances, etc. Decorative possibilities of lighting will be developed.

Industrial Lighting Exhibit at Montreal.—Under the auspices of the Electrical Co-operative Association of the Province of Quebec an industrial lighting exhibit has been held this week at Montreal, three demonstrations daily being given by S. G. Hibben of the Westinghouse Illumination Bureau, New York City.

Milan Served by Interstate.—The Interstate Public Service Company has signed a contract with the owners of the electric light company at Milan, Ind., to furnish energy from the company's plant at Aurora, Ind. Milan, with only 1,000 population, has recently built a new sanitarium which is completely electrified. A three-phase, 13,200-volt line to Aurora is being built.

State Ownership Bill in Wisconsin.—Legislation to bring about ultimate state ownership of privately owned and operated electric light and power companies in Wisconsin is sought by a bill which provides for the conservation and utilization of water sites by the state to develop electric power. This bill carries an appropriation for a survey of potential or undeveloped water-power sites in the state and prohibits the leasing or giving away of natural resources that may develop power.

Northern Indiana Power Company Organization.—The organization of the Northern Indiana Power Company, which has been noted in the news columns of the ELECTRICAL WORLD, is formally announced as follows: The consolidation takes in the Indiana Railways & Light Company, Wabash Water & Light Company, United Public Service Company, Noblesville Heat, Light & Power Company, Roann Light & Power Company and Sheridan Water, Light & Heat Company. Joseph H. Brewer, Grand Rapids, Mich., is the president of the new company. The other officers are: Vice-president and general counsel, L. J. Kirkpatrick; vice-president and treasurer, Harry R. Ellis; vice-president and general manager, Phil. H. Palmer. The Roann properties come under the management of the Wabash office and the Sheridan properties under the Noblesville management.

Sleet Storm Puts Alabama Company on Its Mettle.—Almost the whole construction department in the Birmingham district of the Alabama Power Company turned out to help the operating department clear up line and telephone breaks caused by a heavy sleet storm early in the month. The failure of a steel tower between Bessemer and Magella badly crippled the service in Birmingham. Temporary service was restored in record time by stringing the 110,000-volt "A" line to convenient trees until the steel tower could be replaced. The efficiency of the relay system was also demonstrated as every line that

sent in a trouble report was properly cleared and not a single faulty relay operation was recorded. The company's radio broadcasting station was used to advantage in reporting the load and voltage every half hour to the generating plants and primary substations.

Buffalo Improves Street Lighting.—A new circuit of 200 inverted magnetite-arc lights has been installed for a distance of several miles along Niagara Street, Buffalo, by the Buffalo General Electric Company. This company has contracts for placing 800 street lamps of the same type in the business district of Buffalo during 1923.

Milwaukee Utility Buys New Property.—The Milwaukee Electric Railway & Light Company announces that it has acquired the plant and other equipment of the Dousman Electric Light & Power Company, 33 miles west of Milwaukee, from L. J. Bischel. The consideration was not made known.

Potsdam (N. Y.) Central-Station Company Extends Service.—The St. Lawrence Transmission Company of Potsdam, N. Y., has completed a 24-mile, three-phase, 22,000-volt high-tension transmission line from Potsdam to Waddington for distribution and municipal lighting in Waddington, Madrid and Chipman and for distribution along the route.

How to Pay Off the War Debts.—A Pittsburgh engineer has submitted a plan to the Canadian government for utilizing the waste power of Niagara Falls to pay the war debts of the world. He asserts that with the co-operation of Canada, Great Britain, Belgium and the United States this can be done in twenty-five years. He would simply dig two tunnels 80 ft. in diameter and 25 miles long between Lake Erie and Lake Ontario. Utilizing the 250-ft. head thus gained, he would generate 5,000,000 hp. of electrical energy a day and sell it within a radius of one thousand miles for an average price of $82 per horsepower-year. The engineer-philanthropist is sure the thing could be done for two hundred million dollars.

Storage Capacity in Utah.—Flood control through regulation of the storage capacity in reservoirs on the Sevier River is proposed by R. E. Caldwell, Utah State Engineer, who has compiled tables showing that in the nine years ending with 1921 the annual flow of water into the Piute Reservoir was sufficient to fill that reservoir during the months of January, February, March and April in seven of the nine years. The stream measurement data on the stream show conclusively that the larger flood season comes in May and June. Thus it appears advisable to empty the reservoir completely in January of each year and gradually to build up the storage from the floodwaters, preventing the river from overflowing its banks. Mr. Caldwell's plan is that the reservoirs on the lower Sevier shall build up their storage during the first few months of the year and the upper reservoirs utilize the waters during the later season.

Southern Indiana Security Issue.—Issuance of $3,266,900 of securities and $400,000 in 7 per cent preferred stock by the Southern Indiana Gas & Electric Company, which has its main office in Evansville, has been authorized by the Indiana Public Service Commission. The amounts will be used to replenish the company's treasury, for repairs and extensions made and to be made and to retire outstanding stocks and bonds. The bond issue will bear 6 per cent and mature in twenty-five years. The company spent about $800,000 last year for machinery and extensions.

Dissipating Clouds with "Electric Sand."—Precipitation has been caused and clouds have been made to disappear in a series of experiments conducted at McCook Field, Dayton, Ohio, according to a widely recorded announcement made by the experimenters, Prof. Wilder D. Bancroft of Cornell University and L. Francis Warren. The experiments were made with the co-operation of the Army Air Service. The clouds were made to disappear and precipitate their moisture by the dropping of electrically charged grains of sand upon them from airplanes, according to the experimenters. Professor Bancroft and Mr. Warren assert that the process will be of great value in the commercial world, as fogs over cities, harbors and flying fields can be made to disappear, thereby insuring safety to travel and transportation. They do not contend that in every instance rain or precipitation can be produced, as all clouds do not contain sufficient moisture.

Associations and Societies

National Safety Congress to Be Held at Buffalo.—The National Safety Council will hold its national safety congress for 1923 at Buffalo on Oct. 1 to 5, according to announcement by W. H. Cameron, managing director.

Butte Electrical Men Organize.—Members of the electrical industry in Butte, Mont., have recently formed the Electric Club of Butte, to promote the personal welfare of the members and to improve electric service for the public. M. E. Buck was elected president, H. M. Latham vice-president, K. M. McNeill secretary, and W. C. Medhurst treasurer. The club has rooms in the Montana Electric Building.

March Section Meetings of the A. I. E. E.—The following Institute section meetings have been scheduled for March, 1923: Boston, March 13, "Design of Transformers and Other Features of Queenston Plant," by M. E. Skinner, and "Trend of Power Transformer Development," by M. O. Troy; Detroit-Ann Arbor, March 16, associated technical societies' meeting; Philadelphia, March 12, "Recent Developments in Thermionic Tubes," Saul Dushman; Pittsfield, March 1, "Behind the Screen with the Movie Makers," Rowland Rogers; Worcester, March 15, "The Development of Illumination," W. D'A. Ryan.

Pacific Coast A. S. M. E. to Discuss Water Power.—The first Pacific Coast regional convention of the American Society of Mechanical Engineers will be held in Los Angeles on April 16 to 18. H. A. Barre, electrical engineer for the Southern California Edison Company, will present a paper on "Mechanical Features in Design of Long-Distance Transmission Lines on Hydro-Electric Systems," and Robert Sibley, Pacific Coast consultant for the McGraw-Hill Company, one on "Industrial and Electrical Development on the Coast."

American Physical Society.—For the meeting of this society at Columbia University, New York City, today (Feb. 24) papers of electrical interest are scheduled as follows: "Dispersion of Light by an Electron Gas," by Leigh Page, Yale University; "The Cause of Ionization in the Carbon Arc," by K. T. Compton, Princeton University; "The Contact Electricity of Solid Dielectrics," by Harold F. Richards, Princeton University; "Duration of Resonance Radiation in Mercury Vapor," by Harold W. Webb, Columbia University; "The Change in the Emf. Between a Metal Plate and a Solution After Being Suddenly Brought Into Contact," by R. D. Kleeman and R. H. Bennett, Union College.

Coming Meetings of Electrical and Other Technical Societies

[A complete directory of electrical associations is published in the first issue of each volume. See Jan. 6 issue, page 78, for latest list.]

Pennsylvania State Association of Electrical Contractors and Dealers—Lancaster, Feb. 28. M. G. Sellers, 1518 Sansom St., Philadelphia.

Oklahoma Utilities Association—Oklahoma City, March 12-14. O. D. Hall, 1106 First National Bank Bldg., Oklahoma City.

Southwestern Division, N. E. L. A.—Oklahoma City, March 14-16. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

Illinois State Electric Association—Chicago, March 14-15. R. V. Prather, 305 Mine Workers' Bldg., Springfield, Ill.

Wisconsin Utilities Association—Milwaukee, March 22-23. John N. Cadby, 445 Washington Bldg., Madison.

Tri-State Water and Light Association—Birmingham, April 17-20. W. F. Steiglitz, Columbia, S. C.

American Physical Society—Washington, April 21. D. C. Miller, Case School of Applied Science, Cleveland.

American Institute of Electrical Engineers—Spring convention, Pittsburgh, April 24-26; annual convention, Swampscott, Mass., June 25-29; Pacific Coast convention, Del Monte, Cal., Sept. 25-28.

American Electrochemical Society—New York, May 3-5. Colin G. Fink, Columbia, University, New York.

Southwestern Public Service Association—Fort Worth, Tex., May 15-17. E. N. Wills, 403 Slaughter Bldg., Dallas, Tex.

Electrical Supply Jobbers' Association—executive committee and general meeting, Hot Springs, Va., May 21-25. Franklin Overbagh, 411 S. Clinton St., Chicago.

American Society of Mechanical Engineers—Montreal, May 28-31. C. W. Rice, 29 West 39th St., New York.

National Electric Light Association—New York, June 4-8. M. H. Aylesworth, 29 West 39th St., New York.

Electric Power Club—Hot Springs, Va., June 11-14. S. N. Clarkson, Kirby Bldg., Cleveland.

Pacific Coast Electrical Association—San Francisco, June 19-22. S. H. Taylor, 527 Rialto Bldg., San Francisco.

American Society for Testing Materials—Atlantic City, June 25-29.

Commission Rulings

Suspension of Operation Not Justified by Failure of Competing Company to Furnish Energy.—The suspension of operation by a public service company having a permit to operate should not, the Wisconsin Railroad Commission held in barring out the Badger Public Service Company from Calumet (ELECTRICAL WORLD, Dec. 2, page 1237), be excused as a justifiable or involuntary suspension on the ground that the failure to serve is due to the failure of a competing company to supply energy. The Wisconsin law, the commission asserted, regards each utility as a separate and self-sufficient entity.

Rates for Traffic Lights.—A flat rate for traffic light service, used by municipalities in streets and highways for the guidance and regulation of vehicles, was approved by the Michigan Public Utilities Commission for the Detroit Edison Company. Usually, the company stated, only one lamp is required at each traffic location. This lamp burns all night and is commonly allowed to burn continuously to save the trouble and expense of turning it on and off. The company held that the cost of making such installations was prohibitive and that they did not fall under any commercial classification. Ordinarily these lamps are not connected with street-lighting circuits. In cases where they are so connected the commission took note of the fact that the company applies the street-lighting rates.

Proper Charge for Rural Service.—The Badger Utility Company recently filed an application with the Wisconsin Railroad Commission for permission to establish a rule providing for a connecting charge of $110 for farmers desiring service from its high-tension line who did not take a share of stock at the time the line was built. Granting this petition, the commission said: "We must bear in mind that rural electric service as we know it now is not, as a general thing, capable of supporting the full cost of the service including a return on the capital, and, consequently, unless the rural customer is to pay a part or all of the construction cost, the service either will not be furnished or customers residing in cities and villages must make up the loss, or the loss must be carried by the utility. It is not fair to assume that utilities will generally extend service into rural districts at a loss nor that local customers should be required to make up that loss. Consequently, if the rural districts are to have electric service, rules must be approved which will provide proper conditions under which lines shall be constructed so that the service can be self-supporting. A refusal to approve the rule in this case might or might not adversely affect customers who desire to receive service from the line in question, but it would almost certainly have the effect of putting the company in a position where it could not afford to furnish extensions for other rural customers and where it is quite likely that the commission could not order the furnishing of such extensions since the failure to have a proper connection charge would mean that the extensions could not produce enough revenue to meet the cost of service."

Invasion of Territory.—The Morris & Somerset Electric Company brought complaint against the Commonwealth Electric Company and sought to prevent the authorization by the New Jersey Board of Public Utility Commissioners of the issue of securities by the latter company, charging that the Commonwealth company was infringing on the territory of the complainant. It appeared that the Commonwealth company had contracted to supply electrical energy to the Millburn Electric Company for distribution and for that purpose had agreed to construct a 33,000-volt transmission line to bring energy from its Morristown plant to the Millburn company's wires and also to supply twenty-nine customers along the route. The Morris & Somerset company claimed that this business belonged by right to it, but the board confirmed the Commonwealth company's contract and authorized the securities, holding that an electric utility which has extended into territory nearer to another utility's system than to its own should not be ousted when the other utility has made no effort to develop the territory and when there is not sufficient disparity in the cost of service to justify such action.

Municipality Ordered to Lower Rates.—Ordering a reduction of 25 per cent in the power rates made by the Borough of Vineland for customers outside the borough limits, the New Jersey Board of Public Utility Commissioners said: "As a part of the borough's electric operating revenue deductions no taxes are included, and in comparing its cost of operation with a private corporation an allowance for taxes should be made. In the case of privately operated electric utilities these amounted in 1921 to approximately 9 per cent of the gross revenues. An allowance should also be made for a higher cost of administration or management, inasmuch as almost invariably in the case of a municipal plant not all of the time of every municipal officer properly assignable to the operation thereof is charged as a part of the operating expenses. If no consideration were given to these two items in fixing rates to be charged the consumers of electrical energy would be getting all of the benefits accruing to the borough from the operation of the electric plant as a municipal undertaking. These benefits belong to the taxpayers as such and not to the consumers of electrical energy as such. In order to be fair to the former, the net return should be sufficient to include the amount which in the case of a private undertaking would be paid out for taxes and higher administration expenses."

Recent Court Decisions

Assumption of Risk by Lineman Using Hook Without Safety Catches a Question for Jury.—In French vs. Southwestern Telegraph & Telephone Company, an action to recover damages for the death of a telephone company employee who fell while descending from a platform built on a high pole to ground by means of a hand line, because a hook by which the hand line was suspended from a wire slipped off the wire, the question of whether he assumed the risk of using this hand line, though the hooks were open and had no safety catches to prevent them from slipping from the wire, was held by the Court of Civil Appeals of Texas to have been rightly left for the decision of the jury, and a verdict for the plaintiff was therefore upheld. (245 S. W. 997.)*

Ordinance Granting Franchise Fixing Maximum Charge a Contract.—The Supreme Court of Nebraska has declared, in City of University Place vs. Lincoln Gas & Electric Light Company, that an ordinance reciting "that, in consideration of the rights and privileges granted herein, the grantees shall have a right to charge not in excess of $1.50 per 1,000 cu.ft. of gas," etc., which was accepted by the company, constituted a contract the obligation of which may not be impaired by either party. Whether or not the state, by the exercise of its paramount authority to regulate rates which may be charged by public utility corporations, could intervene upon a showing that the rate fixed by the contract was unreasonable or confiscatory was not decided. (191 N. W. 432.)

Powers of Oklahoma Commission.—From an order of the Oklahoma Corporation Commission directing the Oklahoma Natural Gas Company to furnish natural gas to the Chickasha Gas & Electric Company for distribution the first-named company appealed to the Oklahoma Supreme Court. Reversing the commission's decision, that court holds that where a public utility has undertaken and professes to serve the inhabitants of certain cities and towns within the state the commission has power, within constitutional and reasonable limitations, to compel such utility to serve all inhabitants thereof who may apply for such service, but that the commission is without power to compel a public utility to furnish its product to a community which it has not undertaken or professed to serve and which it is under no obligation to serve, since to require the utility to serve such community would be tantamount to the taking of private property for public use without just compensation. (211 Pac. 401.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men
Engaged in all Branches of the Electrical Industry

Learned and Hecht Vice-Presidents Northern Illinois

John G. Learned and Julius L. Hecht, who have been elected vice-presidents of the Public Service Company of Northern Illinois, as was announced in the Feb. 10 issue of the ELECTRICAL WORLD, have been identified with the electrical industry for a number of years. In 1898 Mr. Learned became associated with the Chicago Telephone Company, now the Illinois Bell Telephone Company, and on leaving that company two years later he became a salesman for the Commonwealth Edison Company. In 1905 he resigned from that organization to become general contract agent for the North Shore Electric Company, where he remained until 1911, when the company became part of the Public Service Company of Northern Illinois. At that time he was made general contract agent for the northern and western divisions, and in August of the following year he was made assistant to the vice-president of the company in charge of the commercial, advertising and right-of-way departments. Later he was made commercial and new-business manager, which position he held at the time of his recent promotion. Mr. Learned will continue in charge of the same division.

Julius L. Hecht has been general superintendent since 1921. He was graduated from the Massachusetts Institute of Technology in 1904, and the following year he became construction engineer for the North Shore Electric Company. In 1907 he was made mechanical engineer in charge of stations. In 1915 he was appointed superintendent of electrical production for the Public Service Company and in 1921 assistant to the vice-president in charge of operation with the duties of general superintendent, the position he held at the time of his promotion to the vice-presidency. Mr. Hecht will have charge of the engineering and operation departments.

John O. Montignani, formerly engineer of electric distribution and division superintendent with the Rochester Gas & Electric Corporation, is now associated with the Westchester Lighting Company, Mount Vernon, N. Y., as assistant electrical engineer.

Harold P. Dayton, who for three years has been the assistant treasurer of the Haverhill Gaslight Company, has been transferred to a similar position with the Truckee River Power Company at Reno, Nev. The Reno company is under the management of Stone & Webster, Inc., and serves an extensive territory in the western part of the state. Mr. Dayton has been associated with the Stone & Webster organization since 1914 and was a traveling auditor for several years before going to Haverhill.

Director of Washington Committee on Utility Information

E. H. Thomas, who has been placed in charge of the newly organized Washington Committee on Public Utility Information as director, with offices in the Henry Building, Seattle, is a newspaper man of broad experience, covering a period of twenty-seven years. He was formerly managing editor of the Seattle *Post-Intelligencer*.

E. H. THOMAS

In addition he has had eight years' experience in public utility publicity work, having been publicity director for the Puget Sound Power & Light Company.

As Mr. Thomas sees it, the committee of which he is the director exists to furnish accurate information and facts about the public utility business to any citizen or group of citizens. The long experience which he has had as an active newspaper man has taught him the things in which the public are interested, and his previous association with public utility work has furnished him with a fund of information as to the sources contained within the utilities themselves for obtaining material that has a popular appeal and at the same time is grounded on facts.

Ralph E. Thurston, manager of the Putnam (Conn.) Light & Power Company, became manager of the Danielson & Plainfield Gas & Electric Company on Feb. 1. Mr. Thurston retains the managership of the Putnam utility.

B. C. Edgar Merger Company's General Manager

B. C. Edgar, who was vice-president and general manager of the Chattanooga Railway & Light Company and the Tennessee Power Company before they were merged with the Chattanooga & Tennessee River Power Company into the Tennessee Electric Power Company, retains his former title in the merger company. Mr. Edgar is also associated with the Nashville Railway & Light Company and at one time was assistant general superintendent of the Columbus (Ohio) Railway, Power & Light Company. W. C. Campbell remains with the new company in the capacity of assistant to the vice-president and general manager. The engineering and operating department of the new company retains most of the engineers who were with the component companies, but in slightly different capacities. J. A. Longley is general superintendent in charge of all engineering and operation of the power and transmission department, H. Crumbliss, Jr., chief civil engineer, J. R. Anderson, chief hydraulic engineer, George W. Christians and O. J. Miller electrical and mechanical engineers on new development work, E. C. Williamson electrical engineer on all other work than that of new development, M. M. Roddey superintendent of operation, and F. R. Atkins superintendent of power and substations. E. D. Reed remains as general superintendent of the Chattanooga district, which is the largest single center of energy utilization. H. B. Whitman is assistant general superintendent of both departments.

E. H. Lewis, who has recently been appointed general superintendent of the St. Louis County division of the Union Electric Light & Power Company and general manager of the St. Louis County Gas Company, became associated with these organizations in 1915, when he joined the engineering and sales departments. In 1920 Mr. Lewis became assistant treasurer of both companies, and one year later he was appointed treasurer of the St. Louis County Gas Company. He filled this office and that of assistant treasurer of the Union Electric Light & Power Company until his recent promotion.

L. F. Leurey, consulting electrical engineer of San Francisco, was elected to the office of president of the San Francisco Electrical Development League at the election held at the annual meeting on Feb. 12. The present secretary-treasurer, J. W. Mahoney, of the General Electric Company in the city, was re-elected by the members of the league. A. U. Brandt, electrical engineer, San Francisco division of the Pacific Gas & Electric Company; D. I. Cone, protection engineer of the Pacific Telephone & Telegraph Company, San Francisco, and C. Todt, Pacific States Electric Company, were named as the new members of the executive committee of the electrical association.

P. B. Postlethwaite Vice-President of Wagner Electric Corporation

Preston Barr Postlethwaite, one of the newly elected vice-presidents of the Wagner Electric Corporation, has been associated with that organization since 1909, when he took its apprentice course. In February, 1910, he went to the Cincinnati office as a salesman, where he became branch manager in 1913 and district manager in 1915. Mr. Postlethwaite was called to the Wagner Electric factory at St. Louis in November, 1916, to organize and take charge of the service department, and three years later he also took over the automotive department. His experience as vice-president of several subsidiary companies of the Wagner Electric Corporation made him the natural choice for the vice-presidency of the newly formed Wagner Electric Corporation. Mr. Postlethwaite was born in Huntington, Pa., and is a graduate of Pennsylvania State College.

J. L. Stannard of San Francisco was named chief engineer for the construction of the first unit of Tacoma's new five-million-dollar Lake Cushman power project.

William Seiple, until recently an official of the Indiana Street Railway Company, is now associated with the Pennsylvania Power & Light Company in the Wilkes-Barre district.

L. H. Ames is the new superintendent at the Muscle Shoals plant of the Alabama Power Company, succeeding C. B. McManus, who was recently promoted to the position of manager of the western division.

Norris C. Husted, who has been a sales engineer for Hubbard & Company for the past five years, has been made manager of the Hubbard Pressed Steel Company, Niles, Ohio, a subsidiary of Hubbard & Company.

Homer G. Hall, who has been covering the territory in the Madison (Wis.) section for the General Electric Company for many years, has severed his connections with that company to become associated with the Julius Andrae & Sons Company of Milwaukee.

F. O. Evertz, superintendent of the electrical department of the Ohio Inspection Bureau, was recently elected president of the Western Association of Electrical Inspectors. Mr. Evertz has been an active member of this body and has served as vice-president and a member of the board of directors

T. T. McLemore has replaced E. R. Wall as division superintendent of the western division of the Alabama Power Company. Mr. Wall resigned to accept a position with the power department of the Birmingham Railway, Light & Power Company. W. M. Craven will act as assistant division superintendent.

Chief Justice E. E. Corfman of Salt Lake City, for six years head of the Utah Supreme Court, has been appointed by Governor Mabey as a member of the Public Utilities Commission of that state to fill the vacancy caused by the recent death of Judge A. R. Heywood. Judge Corfman has been a prominent member of the legal profession in Utah for many years.

Clifford G. Hillier has been appointed manager of the merchandising department of the Westinghouse Electric & Manufacturing Company, New England office, with headquarters in Boston. He succeeds F. L. Nason, who has been appointed assistant manager of the central station department of the Boston office.

C. J. Stoll Works Manager Hawthorne Plant of Western Electric

C. J. Stoll has been appointed works manager, to remain in Chicago, upon the transfer to New York of the executive headquarters for the Western Electric Hawthorne plant. After obtaining his degree of electrical engineer from

C. J. STOLL

Penn State College, Mr. Stoll joined the Western Electric Company in 1903. He received charge of its new-apparatus design department in 1905 and six years later became head of the manufacturing branch of the Western Electric shop in New York. In 1912 he went to Belgium as shop superintendent of the Antwerp branch, returning to America a year after the war had started. Since that time he has been operating superintendent, technical superintendent and assistant general superintendent of the Hawthorne works.

John P. Crowley of St. Paul was recently elected vice-president and general manager of the St. Croix Power Company, Somerset, Wis.

Kempster B. Miller has resigned as general manager of the North Electric Manufacturing Company, Gallion, Ohio, to enter the consulting engineering field in Pasadena, Cal.

W. M. Casey, who has been superintendent of transportation for the International Railway Company of Buffalo, has gone to Atlanta to become superintendent of the Georgia Railway & Power Company.

O. D. Allen has been appointed manager of the Coghlin Electric Company, Worcester, Mass., electrical supply jobbers and contractor-dealers.

Augustus C. Smith, sales manager of the Buffalo General Electric Company, was elected chairman of the electrical group of the Chamber of Commerce of Buffalo.

William T. Walker has recently become sales manager and vice-president of the Jeannin Electric Company, Toledo, manufacturers of single-phase motors. Mr. Walker was formerly connected with the automobile industry.

Renshaw Borie is now associated with McClellan & Junkersfeld, Inc., in their work of engineering, construction and management and is in charge of their Philadelphia office.

W. J. Jockers, sales manager of the St. Paul Electric Company, was made vice-president and a member of the board of directors at a recent meeting of that body. Mr. Jockers will continue in his capacity as sales manager in addition to his new duties.

Cloyd M. Chapman, who has been active in the work of the American Society of Testing Materials and the American Concrete Institute, has become affiliated with Dwight P. Robinson & Company, Inc., as consulting materials engineer.

C. F. MacMurray has replaced J. S. Dales as president and general manager of the Colon Electric & Ice Supply Company, vice-president and general manager of the Ciá Panamena de Fuerza y Luz and of the Ciá Panamena de Telefonos and general manager of the Panama Electric Company. Mr. MacMurray was graduated from Syracuse (N. Y.) University in 1906, and previous to occupying his present position he was manager of the Colon Electric & Ice Supply Company.

James L. Mahon, who for seven years has held the position of advertising manager of the P. A. Geier Company of Cleveland, was appointed merchandising manager of that company on Jan. 1. With Carl M. Randel, director of sales, he will be in charge of the merchandising policies of the company's entire electrical output. Prior to his connection with the Geier company, Mr. Mahon was with the Buckeye Lamp Division, a branch of the National Lamp Works of General Electric Company, and he was also for some months an officer of the Carpenter-Kingston Advertising Company of Cleveland. For the time being Mr. Mahon will continue to supervise the company's advertising in addition to his new duties.

Obituary

Patrick C. Fitzpatrick of Springfield, Mass., an electrical contractor since 1891 and one of the longest established in that section of Massachusetts, died Feb. 3 in St. Petersburg, Fla., at the age of sixty-three.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

Used Machinery—A New Industry Asset

How It Has Shaken Off the Blight of the Second-Hand Idea and Come to Be an Economic Service to the Central Station

By Frank MacGovern
MacGovern & Company, New York

MEN of industry are rapidly developing a new mental attitude toward power equipment and other machinery that has been used and has come again into the market. The blighting influence of the term "second-hand" is being shaken off, and as "used machinery" it is taking its place in the market with all the respect due to legitimate goods when openly sold to people of standing in the community by concerns of unquestioned responsibility.

The stigma of the "second-hand" idea is not hard to trace back to the early days when trade was principally confined to crops and domestic animals, jewels and works of art, clothing and implements for personal use. Crops and animals, jewels and art objects were freely bartered and lost no value in changing hands. But personal effects naturally were depreciated with personal use and contact and were sold at a sacrifice more because their "social standing" was impaired than because of actual decreased value. They were called "second-hand" and the term has carried a taint. Buy a horse or a cow from any one and you pay its worth, but a thing called "second-hand" is expected to be priced down because of the bad name.

Influence of the Used Car

The automobile brought new thinking on the subject, because people were continually buying new and better cars and here were their old cars still good for service. So other people have bought them until there is no social stigma today in buying a "used" car—which may, in fact, be a rebuilt car—and we do not even call it "second-hand." True, used cars have been greatly depreciated in price, but the improvement of automobiles has been very rapid and the element of style influences the demand in a degree out of all comparison with more standard types of machinery. As a matter of fact, there has been very little change in the design of electrical machinery during the last eight years or more. There have been very few exceptions, the conspicuous case being the large sizes of turbine, in which there has been improvement in efficiency.

Frank MacGovern

Therefore the fact that the equipment may be a few years old has no effect upon it. Its efficiency and its worth depend not upon its age but its condition.

The stresses of the war have brought this same kind of a change in the attitude of industry toward used machinery. During the great need any piece of available "used" machinery was eagerly grabbed up for the value that was in it. And with the end of the war and the arresting of plant expansion a large quantity of machinery was thrown on the market, by the government and by manufacturers, some unused, some used but little, and its intrinsic value was so palpable that it has all been accepted as "used" and not "second-hand" equipment and has been bought according to its worth at what price negotiation could develop but without direct depreciation for any loss of "social" standing.

The great war plants at Hopewell, Nitro, Nashville and other points were dispensed in this way. Moreover, a great deal of absolutely new machinery has been brought onto the market, through a variety of causes, which must be sold by owners other than the original manufacturers, and this equipment too is sold by the used-machinery dealer. A recent spectacular example was the 20,000-kva. power plant which the government erected at Edgewood Arsenal. This plant has within the month been acquired by my company. There were two turbines with condensers and auxiliaries aggregating 17,500 kw., a complete switchboard with bench control of remote-operated oil breakers, 8,230 hp. in boilers with stokers, superheaters and soot blowers, and all the other equipment going to make up a complete power plant.

The electrical and power machinery has already been resold to the Denver Tramways Company, thus bringing to the Denver company the opportunity to purchase an extensive new equipment at a price which would have been far greater but for the services of the used-machinery dealer.

This extensive equipment had never been installed, but twelve years ago there would have been some hesitation on the part of the purchaser to buy equipment of this importance without a manufacturer's guarantee. The reputation of this used-machinery dealer has become so stabilized, however, because of the large amount of used equipment that is being sold, that the fact that this machinery is not absolutely new is no longer any serious obstacle to its resale and utilization.

How Used Machinery Market Helps

But the vicissitudes of peace and progress are greater than the urgencies of war when it comes to electrical machinery. The growth of the industry is constantly forcing the abandonment of used machinery. Light and power companies are constantly buying new and larger machines and releasing smaller units,

which are bought by industrial plants or other utilities. Private plants are abandoned by companies that decide to take on central-station service. This equipment thereby becomes available to industry and can be acquired at considerably less than the first cost. In small stations this often makes possible the taking on of additional load in waiting business that could not be immediately financed if new apparatus at the full price had to be purchased.

The maintenance of an established market for used machinery, therefore, renders an economic service of great value to the industry. It establishes a place to sell used machinery and a place to buy it, and the dealer contributes also a further service of adaptation, for he rebuilds machinery, changing the voltage or some other desired detail or combining two machines into a motor-generator set as the customers' needs require. Another important service comes in the matter of deliveries, for in these days when manufacturers are sold far ahead of their capacity to produce, used machinery can be secured to meet emergencies.

This often makes possible the taking over of a private plant, for the ability of the central station to secure the load often hinges on the satisfactory sale of the installed machinery. Often it assists the enlargement of an industrial plant in the same way.

Responsibility Makes Safety

One of the old obstacles to the sale of used equipment was the feeling that it was buying a "pig in a poke," but those days have passed. The business has been lifted to a dignified position by the development of used-machinery firms whose standards are of the highest and whose responsibility is ample.

The value of a boiler is established by the insurance certificate that covers it. The value of a turbine, an engine or other equipment can be established by experts. The responsibility of the firm that sells the used machinery is a matter of record and reputation.

Buying from a dealer whose good name and ample resources stand behind his guarantee is no less safe and profitable than buying from the maker of the apparatus. Therefore the resale of used machinery has grown into an established business of great volume in recent years and is resulting in a service to the central stations and industrial plants of this country of inestimable value.

There is hardly a prominent central station or important manufacturing concern in this country or in Canada that has not purchased used power equipment within the last dozen years, and the sales to smaller companies are large. The used-machinery business, in short, has won social standing and shaken off the damning influence of the old second-hand idea. In so doing it has become a distinct asset to the electrical industry.

Export Business for the Electrical Jobber

Some Definite Advice as to Existing Opportunities and the Methods by Which Foreign Trade May Be Developed by the Wholesaler

By R. A. Lundquist
Chief Electrical Equipment Division, United States Bureau of Foreign and Domestic Commerce

MANY instances exist where buyers in the less developed markets of the world cannot place large orders and where their requirements cover only a few each of numerous items. There are generally no regular import merchants with stocks of electrical goods in such places, and American electrical jobbers in strategic locations can well afford to cater to that class of trade, which is now often handled through indirect channels that do not tend to develop the possibilities that exist.

Again, it often happens that a foreign electrical dealer who normally does business in considerable volume through a general export house or other channels may urgently need a particular class of material or may want a modest mixed order of rather technical items shipped promptly. Such cases occur regularly in the electrical trade where a consumer calls for something out of the ordinary, and they present real opportunities for jobbers who can fill such orders without delay. It is a question of service largely—service rendered with promptness, efficiency and a full understanding of what is wanted—and the purchaser is willing to pay a margin to the jobber for that service. The smallness of the order and the limited quantity of individual items involved do not make such business attractive to manufacturers, but it should be profitable to jobbers, since it will invariably exceed in amount the average domestic order.

The business done by general export houses has been confined mainly to rather staple lines purchased in fair quantities from manufacturers, with the export houses acting as buying agents and shippers for the foreign customers. Much of such existing business will remain in the hands of general export firms in view of the fact that such items are frequently a part of a considerable order for mixed lines of merchandise, and that the business connections are of long standing. However, while general export houses do handle small miscellaneous orders of purely electrical goods, they are seldom prepared to fill promptly orders involving more or less technical items, nor are they in a position usually to seek such business aggressively from the foreign buyers. Their field lies largely in dealing with manufacturers on behalf of foreign clients who anticipate their requirements well in advance and who therefore buy in reasonably large quantities.

The Promising Field

Canada is so closely bound up with our domestic merchandising that others of our neighbors present more promising fields. Mexico, the Central American republics, the West Indies, and to some extent a few of the northern countries of South America, offer the best prospects for the class of trade first discussed. There are no electrical importers who cover these countries throughout, and the electrical dealers and electric lighting companies in outlying places often do their buying of American supplies through indirect non-technical channels, though it must be said that more efficient means are usually provided for European goods.

Where prompt service is the controlling factor, or where special items are needed in small quantities, jobbers are able to sell goods to larger markets still—to Australia, New Zealand, China, India and to most of South America. This latter class of business is, of course, not steady, but it is worth while catering to.

Jobbers cannot afford to spend a great deal of money to open up ac-

counts in markets that promise only a limited volume of business. Catalogs sent to a hand-picked list are probably the most efficient means of approach, but the way for sending such catalogs should be paved by well-prepared letters describing the activities of the company and courteously requesting permission to do so. Unsolicited catalogs mailed to foreign firms, upon which they may be required to pay duty—and not infrequently short postage—are a source of irritation. Duties on catalogs should be arranged for by the sender, if possible, but at any rate the foreign firms should be informed as to what is to be sent them and under what conditions. One point that the jobber should emphasize is that he is purely a wholesaler and that he is seeking business on the basis of service—shipment from stock, assortment of items in quantities that will meet the needs of the buyer, and technical understanding of his requirements.

Business connections in outlying countries should be put on a more personal basis than is common in this country. Circular letters should be avoided so far as possible. Announcements of new lines or of special opportunities should be made in a more quiet manner than usual for the American trade. The foreign buyer wants to be kept advised of all new developments in the electrical field, but he appreciates them most fully when they are outlined to him in concise and courteous terms and with complete information.

Jobbers catering to foreign trade should make specific and uniform arrangements with their overseas customers regarding cable messages and their charges. A foreign firm which cables for quotations is not satisfied with a price list by mail. Cable messages, even when well coded, are expensive, and the charges may be all out of proportion to the volume of the particular transaction to which they pertain, but a policy can be determined upon that will be just to both buyer and seller. In the long run they are part of the margin the foreign buyer pays for prompt service, and he will hardly cable unless his needs are urgent and will bear the expense.

SELLING TERMS

Foreign electrical dealers and central-station companies with which jobbers can establish connections will not as a rule ask for better terms than do American buyers of the same class. Upon beginning relations most foreign buyers are willing to establish credits with bankers in the port of shipment so that the goods will be paid for when the draft, with the documents attached, is presented at a bank. Where other terms are suggested for initial orders or where business relations have been in effect for a reasonable period, and sixty or ninety days' time is desired by the customer, it is always possible to obtain credit ratings from the usual commercial sources or to get insurance against the credit risk if advisable. Where goods are sold to established customers on such terms, the jobber will usually be able to discount the drafts through his usual banking connections.

There are certain specified routine details to be attended to in shipping goods abroad, there are various difficulties in language to be met, but on the whole the so-called intricacies of foreign trade disappear before common sense. The foreign buyers of electrical goods are reasonable business men with a good knowledge of what they want and with a willingness to play fair. Much of their business will continue to go direct to manufacturers and some to general export houses, but there is a certain portion of it that should and can fall to the electrical jobber.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

Atlanta Collections Better

Jobbers in Atlanta report January collections as unusually good, even above optimistic estimates, with one jobber stating that his February collections are on a par with those of January. Another jobber, however, states that there seems to be a tendency on the part of his customers to pay more slowly than in the prior month. As a whole, collections in north and middle Georgia are in better shape than in the southern portion of the state.

An encouraging sign is that an increasing number of purchasers are taking cash discounts, a year ago these purchasers being unable to pay on even a sixty or ninety-day basis. Credits are still extended with care, but on the whole it can be said that credit is being extended on a less stringent basis than has been the case for some time. The experience of 1920, however, will serve to make credit men quite conservative in opening up new credit lines.

New England Storage-Battery Trade Good

Sales of storage batteries are being maintained in New England on a scale promising better business this year, and while delivery conditions cause some anxiety, recent factory enlargements are helping to meet the current requirements of this and other sections of the country. Replacement orders are coming in well, and of late increased interest has been shown in road trucks and in industrial electrics. A prominent distributing house looks for an excellent year in lighter delivery-wagon battery sales, especially in the laundry and bakery fields.

Fair business is reported in radio batteries, notwithstanding the extending use of dry cells in some receiving sets. The season has not yet opened in starting and lighting batteries. Increasing applications of batteries are apparent in railroad car-lighting service. Stocks are none too large, and some shipments are being made on a four weeks' basis for varied battery service. Prices have shown a tendency to increase slightly in a few lines lately.

Fixture Sales Are Improving

Observation of the demand for fixtures so far this year gives ground for optimism, and if prices continue fairly stable, jobbers and dealers handling this business intelligently should secure an excellent turnover. For months the demand for portable lamps has been active and growing, and the general improvement of business conditions throughout the country has been accompanied by decisions to build new homes and to refurnish old residences and install better lighting in industrial and mercantile establishments. The work of such an organization as the Bureau for Better Illumination at Boston and the increased emphasis being placed upon illumination engineering in central-station circles are bearing fruit.

The desire to move accumulated stocks has resulted in some quarters in price cutting, but it is believed this is affecting only a small proportion of the total volume of business. The popularity of styles is a potent factor in this branch of the trade, and nothing like saturation in design development is in sight. Unquestionably the recent discoveries in Egyptian archeology will be reflected in the design of high-grade illumination equipment, and the use of electric lighting in the actual investigations in the Valley of the Kings represents only the initial contact of the electrical material market with this epoch-making research.

Comparative Prices of Station Supplies

	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars, per lb.	$0.0303	$0.0296	$0.0247
Cold finished shafting, per lb.	0.0397	0.0378	0.0336
Brass rods, per lb.	0.1804	0.1742	0.155
Solder (half and half), per lb.	0.2617	0.2425	0.2075
Cotton waste, per lb.	0.1181	0.1175	0.106
Washers, cast iron (½-in.), per 100 lb.	4.33	4.33	3.83
Emery, disks, cloth, No. 1, 6-in. diameter, per 100	2.96	2.96	3.11
Machine oil, per gal.	0.349	0.36	0.40
Belting, leather, medium, off list	49%	49%	46%
Machine bolts, up to 1-in. x 30-in., off list	51½%	51½%	64½%

Important Data on Electrical Industry for 1921

The Department of Commerce has just announced that, according to reports made to the Bureau of the Census, the value of products of establishments primarily engaged in the manufacture of electrical machinery, apparatus and supplies amounted to $833,986,000 in 1921, as compared with $997,968,000 in 1919 and $335,170,000 in 1914, a decrease of 16.4 per cent from 1919 to 1921, but an increase of 148.8 per cent for the seven-year period from 1914 to 1921.

In addition, electrical products to the value of $49,003,000 in 1921, $65,558,000 in 1919 and $24,262,000 in 1914 were reported by establishments classified in other industries. Electric washing machines, glass and porcelain electrical supplies, electric signs and electric lighting fixtures have been classified under other industry captions, and statistics of their production will be included with those for "washing machines," "glass," "pottery," "signs and advertising novelties" and "gas and electric fixtures."

Of the 1,333 establishments reporting products valued at $5,000 and over in 1921, 220 were located in New York, 166 in Illinois, 161 in Ohio, 116 in Pennsylvania, 113 in New Jersey, 105 in Massachusetts, 73 in California, 60 in Connecticut, 54 in Wisconsin, 49 in Indiana, 47 in Missouri, 40 in Michigan, 16 in Minnesota, 13 in Washington, 12 each in Kentucky and Rhode Island, 11 in Maryland, 8 in New Hampshire, 7 each in Colorado, Iowa, and West Virgina, 6 in Oregon, 5 in Nebraska, 4 in Texas, 3 each in Louisiana, North Carolina and Virginia, 2 each in Alabama, District of Columbia and Oklahoma, and 1 each in Forida, Georgia, Kansas, North Dakota, Utah and Vermont.

Four states reported products valued at more than $100,000,000 each. Illinois, the leading state in 1921, produced 20.2 per cent of the total value of products in that year, New York 17.9 per cent, Pennsylvania 13.9 per cent, and Ohio 12.3 per cent.

In January, the month of maximum employment, 187,075 wage earners were reported, and in July, the month of minimum employment, 149,697, the minimum representing 80 per cent of the maximum. The average number employed during 1921 was 161,204 as compared with 212,374 in 1919 and 118,078 in 1914.

The general statistics for 1921, 1919, and 1914 are summarized in the table. The figures for 1921 are preliminary and subject to such change and correction as may be found necessary from a further examination of the original reports.

U. S. Business Men to Meet British

One thousand business men from this country will join one thousand business men in Great Britain next spring in London, at a conference to promote the development of trade between the two countries, and to try to solve economic problems in which both countries are interested. This was announced recently by F. A. Wilson-Lawrenson, president of the Civitan Club, at a luncheon meeting at the Hotel Astor.

Credit Situation in Portland and Seattle Reported Easier

Collections in the Portland-Seattle territory when compared with those of one month ago are easier with the exception of contractor-dealer accounts. One failure is reported in the retail trade this week and many dealers are having trouble to meet their obligations. However, jobbers and contractors are prospering, while the dealers are experiencing competition from the department stores and other small general stores in outlying districts. Outstanding accounts throughout the Northwest average forty-five days.

ELECTRICAL MANUFACTURING DATA—1914-1921

	1921	1919	1914*
Number of establishments	1,333	1,315	874
Persons engaged	201,952	271,917	144,712
Proprietors and firm members	580	473	368
Salaried employees	40,168	59,065	26,266
Wage earners (average number)	161,204	212,374	118,078
Salaries and wages	$309,936,000	$336,369,000	$109,098,000
Salaries	115,996,000	98,180,000	35,291,000
Wages	193,940,000	238,189,000	73,807,000
Paid for contract work	925,000	1,218,000	291,000
Cost of materials	344,070,000	425,098,000	154,728,000
Value of products	833,986,000	997,968,000	335,170,000
Value added by manufacture†	489,916,000	572,870,000	180,442,000

* Statistics for establishments with products valued at less than $5,000 are not included in the figures for 1921; 126 establishments of this class reported 117 wage earners and products aggregating $351,000 in value. For 1919, however, data for 89 establishments of this class, reporting 80 wage earners and products valued at $253,000, and for 1914, data for 156 such establishments, with 204 wage earners and products valued at $440,000, are included in all items with the exception of "number of establishments."

† Value of products less cost of materials.

The Metal Market

Consumers Continue Extremely Active —Every Week Sees Further Expansions Indicated

Metal consumers continue extremely active, and all metal sellers are highly optimistic for the future. Every week sees further expansions indicated, and it is hard to see why the current year will not be a banner one for practically all non-ferrous metals. Most of the activity is confined to domestic business, but it is felt that a corresponding foreign demand for metals, although likely to be delayed longer than was expected, is nevertheless sure to develop. This foreign demand may finally arrive just in time to take up any slack in domestic business. The copper market at last seems to be permanently on the upgrade; lead is as strong as ever; tin is advancing again, and zinc has again taken a turn for the better.

NEW YORK METAL MARKET PRICES

Copper	Feb. 13, 1923 Cents per Pound	Feb. 20, 1923 Cents per Pound
Electrolytic	15.12½	15.12½
Lead, Am. S. & R. price	8.00	8.00
Antimony	7.50	7.50
Nickel, ingot	30.00	30.00
Zinc, spot	7.00	7.05
Tin Straits	39.00	40.00
Aluminum, 98 to 99 per cent	22.00-23.00	23.00

Copper has shown surprisingly little tendency to linger at the 15-cent delivered level, which was supposed to be rather a stumbling block. Since Friday no copper has been obtainable at that price unless the consumer was extremely favorably situated. Sellers are not anxious to sell further ahead than April without getting a premium, as they feel that the price tendency will continue upward. At the same time, many producers are well sold ahead for the next three months, so the situation is fundamentally sound. Refinery deliveries in January were well over 200,000,000 lb. and are said to have been, with one exception, larger than those of any other month since the war.

The telephone and telegraph and electrical industries generally continue extremely active and are taking extraordinarily large tonnages of copper.

Copper and Brass Products

Copper, brass and bronze mills quote the following prices on brass and copper products:

Copper wire, 17.25 cents net, mill; brass wire, 19.5 to 21.5 cents; copper sheets, 22.50 cents; copper rods, 21 cents; brass rods, 17.50 to 21.62½ cents; sheet brass, 19.25 to 20.87½ cents.

The Week in Trade

Prices When Quoted Are Those Reported at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

HEAVY snows and the colder weather have delayed deliveries in the New England and Western States, with the result that wiring supplies, especially conduit, are noticeably lower than three weeks ago. Some labor demands are causing delays in new construction, which in turn may affect the now healthy demand for all commodities entering into these projects. The rising price of copper has already caused several upward revisions in quotations for wire. The influenza epidemics in large cities are causing an increase in the demand for open-air heaters and heating pads. Other appliances, noticeably flatirons, toasters, cooking appliances and small ranges, are receiving more attention in orders from the dealers. Porcelain, poles and pole-line hardware are selling in better volume in view of the contemplated expansions and repairs to be made by central stations, telephone companies and railways in the next few months. Second-hand-motor dealers are said to be prospering, while much activity is noted among the manufacturers of smaller sizes of motors for spring deliveries to fan makers, who anticipate a very active season. Meters also have taken on increased interest. Much competition prevails among the commercial-fixture manufacturers who are carrying on extensive sales campaigns and who are doing some price cutting. Radio dealers report buying during the past few weeks as decidedly active.

Boston Business continues to improve, although it is handicapped severely by railroad conditions and extreme winter weather. Deliveries are giving much trouble all over New England. Central-station outputs continue to grow and appliance sales are healthy. Building and engineering contracts in New England for the week ended Feb. 13 totaled $3,900,300 against $1,882,100 a year ago. Labor shows a tendency to demand concessions unfavorable to business expansion in the building trades, but conditions are not yet acute. Jobbers report great activity in inquiries and stocks are rather spotty. In some sizes galvanized rigid conduit was practically unobtainable here Monday. More interest is being shown in electric vehicles for lighter delivery service. Sales of motor and control equipment for industrial power applications are better than for many months. Some fixture purchases are delayed by cold weather.

New York Jobbers and manufacturers' agents report a steady demand for all central-station equipment in view of repairs and extensions which will start when the warmer weather sets in. Increases in copper prices has caused some strengthening in the wiring market, while some stocks are lowered due to poor transportation and shortages of raw materials. Lamps are moving in slower volume than one week ago. Commercial-fixture demand is somewhat slower. Motors in the larger sizes are moving in quick succession from the second-hand dealers' stocks. A steady call for heating appliances and electric warmers is reported following the cold days of last week. Collections are reported to be improving.

Baltimore A general slight tendency to increased business in various commodities is reported by the dealers, which, although encouraging, is not taken too optimistically. Most of the houses still remain well stocked, although not overstocked. There are several big electrical installations to be made in this section at the beginning of spring. On the whole, the prospects at the present time are encouraging. The contractors as well as the jobbers are looking for a large spring business in school buildings and residences. The market as a whole is firm.

Atlanta Reports indicate very little change in general conditions since last week. Deliveries are slow, but there have been no shortages as a result with the exception of conduit. Prices of conduit and wire continue to climb. All jobbers report business as satisfactory. One of the largest jobbers has placed orders on manufacturer for fan supplies 50 per cent in excess of last year's orders, and, judging from the number of fan contracts signed for future delivery, this will be the biggest season ever seen in fans. Business in storage batteries continues good. This is a reflection of the improved financial condition and mental attitude of customers in this section, many cars that have been in storage now being operated again. The outlook in this line is particularly bright and prices are generally on the increase.

Pittsburgh Business generally is good. The confidence of the jobbers is being restored, consequently stock orders for standard material are becoming more prevalent. This air of confidence is also being manifested among the dealers to a great extent. It is estimated that the city of Pittsburgh is behind two and one-half years in its building program, consequently a continued increase in business due to building activities is looked for. In the outlying territories one of the large central stations is putting on an extensive house-wiring campaign which is bringing excellent results. The contracts for wiring are in turn being turned over to various contractor-dealers in the towns in which this particular station operates. This is producing a spirit of harmony and co-operation between the central stations and contractor-dealers.

Cleveland Little change has occurred in the market during the past week. Armored cable is in strong demand and so is conduit, with ample stocks and fair deliveries. Commercial fixtures are slower, but firm prices prevail. Although motor sales show no perceptible decrease the demand lessened slightly with firm prices. Storage batteries are active and a few jobbers report desirable orders. Farm-lighting plants are being pushed by advertising, but they are being met with rather indifferent results. Building operations are extensive, despite a recently adopted conservative policy of banks and mortgage brokers, and plans for spring include many large projects. Controversy over a gas franchise and colder weather have promoted the sale of heating appliances to a degree and central-station power sales are in greater volume. Industrial-equipment jobbers are busy. A shortage in radio tubes is reported. Transportation is becoming less difficult. Collections are in better shape.

St. Paul-Minneapolis Business is somewhat unsettled. Lighter orders by dealers show uncertainty compared with the confidence of a week ago. Buying for future use on rising market is slowing up. Cold weather and heavy snows are slowing up construction. Retail buying is poor. However, in spite of upset conditions, business is 50 per cent ahead of last year and spring prospects are good. January business is better than February.

St. Louis A feeling of optimism pervades all branches of the industry since the passage of the $87,000,000 bond issue for civic improvements. The recent cold snap, followed by melting snow and rain, has caused an unusual amount of sickness, resulting in a large demand for heaters and heating pads at a time of year when the sale of these appliances might normally be expected to decrease. Electrical jobbers report continued good business. The shortage in conduit continues, that in enameled conduit being acute. The market for motors continues active with low stocks. Radio buying continues active. Dealers in electrical refrigerating equipment report sales greater than for the corresponding period last year with bright prospects for the spring. Prices show an upward trend and collections are good.

Denver Upward trend on copper prices is showing reaction in house wiring, although several cars of wire recently received have been sold at less than manufacturers' present price because of conditions under which they were purchased. Volume of sales reported from southern part of state

Demand, Supply and Price Trend of Nineteen Commodities as Sold in Sixteen Cities

Explanation:
Demand: Steady, Slow or Active
Supply: Normal, Low or High
Price Trend: Firm, Decreasing or Increasing

Next Week
Reports will include Conduit Boxes, Signal Apparatus and Rectifiers

	Wire	Armored Cable	Conduit	Transformers	Poles	Pole Line Hardware	Porcelain	High Tension Equipment	Fuses	Meters	Switches	Wiring Devices	Lamps	Commercial Fixtures	Motors	Radio	Storage Batteries	Instruments	Farm Lighting Plants
Boston																			
Demand	Act.	Act.	Act.	Sdy.	Slow	Slow	Slow	Slow	Sdy.	Sdy.	Act	Act.	Act.	Act.	Sdy.	Act.	Act.	Sdy.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Low	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Low	Nml.	Nml.
Price trend	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
New York																			
Demand	Act.	Act.	Sdy.	Sdy.	Slow	Slow	Sdy.	Slow	Act.	Sdy.	Sdy.	Sdy.	Act	Sdy.	Sdy.	Act.	Act.	Sdy.	Sdy.
Supply	Nml.	Hi.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.
Price trend	In.	Firm	Firm	Firm	Firm	Firm	Firm	Inc.	Inc.	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Baltimore																			
Demand	Act.	Slow	Act.	Sdy.	Slow	Slow	Sdy.	Slow	Act.	Slow	Act.	Act.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.
Supply	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Dec.	Firm	Firm	Firm	Firm
Atlanta																			
Demand	Act.	Act.	Act.	Sdy.	Act.	Act.	Act.	Slow	Act.	Act.	Act.	Act.	Act.	Act.	Slow	Act.	Act.	Slow	Act.
Supply	Low	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Inc.	Firm	Inc.
Pittsburgh																			
Demand	Act.	Sdy.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.
Supply	Low	Nml.	Low	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm
Cleveland																			
Demand	Act.	Act.	Act.	Slow	Slow	Slow	Slow	Slow	Sdy.	Sdy.	Act.	Act.	Act.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.
Supply	Nml.	Low	Low	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Firm	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Chicago																			
Demand	Act.	Sdy.	Act.	Sdy	Act.	Slow	Slow	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Inc.	Firm	Firm	Firm	Dec.	Firm	Inc.	Inc.
Twin Cities																			
Demand	Act.	Slow	Sdy.	Sdy.	Act.	Slow	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Slow	Act.	Sdy.	Act.	Slow
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
St. Louis																			
Demand	Sdy.	Sdy.	Act.	Sdy.	Slow	Sdy.	Sdy.	Act.	Sdy.	Slow	Sdy.	Sdy.	Sdy.	Act,	Act.	Act.	Act.	Slow	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml,	Low	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
New Orleans																			
Demand	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Slow	Slow	Sdy.	Sdy.	Sdy.	Act.	Act.	Act.	Sdy.	Slow	Slow	Sdy.	Act.
Supply	Low	Nml.	Low	Nml.	Low	Low	Nml.	Low	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Denver																			
Demand	Act.	Act.	Act.	Slow	Act.	Act.	Act.	Slow	Act.	Slow	Sdy.	Act.	Sdy.	Act.	Slow	Act.	Slow	Sdy.	Slow
Supply	Nml.	Low	Low	Low	Nml.	Nml.	Low	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Salt Lake City																			
Demand	Act.	Sdy.	Act.	Sdy.	Sdy.	Slow	Act.	Sdy.	Slow	Sdy.	Sdy.	Sdy.	Act.	Act.	Slow	Sdy.	Sdy.	Sdy.	Slow
Supply	Low	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Hi.	Nml.	Nml.	Nml.	Hi.	Nml.	Nml.	Nml.	Nml.	Nml.	Low
Price trend	Inc.	Firm	Inc.	Firm	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Inc.	Firm	Inc.	Firm	Firm	Inc.	Firm	Firm
Portland-Seattle																			
Demand	Act.	Act.	Act.	Act.	Act.	Act.	Slow	Sdy.	Sdy.	Act	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Act.	Slow	Slow	Slow
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Firm	Inc.	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Inc	Firm	Firm	Firm	Firm	Firm	Firm
San Francisco																			
Demand	Act.	Sdy.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Act.	Sdy.	Act.	Act.	Act.	Slow
Supply	Hi.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml	Low	Nml	Nml.	Nml.	Nml.	Hi.	Nml.	Nml.
Price trend	Firm	Firm	Firm	Firm	Firm	Firm	Dec.	Firm	Inc.	Firm	Inc.	Inc.	Firm	Dec.	Firm	Firm	Firm	Firm	Inc.

and New Mexico indicates more rapid improvement than in northern sections. Country banks are becoming more liberal with credit, although collections from electrical contractors have not improved in the same degree. New construction has been hampered by a few days of cold weather.

Salt Lake City A slight revival of interest in radio is reported with prospects of fair activity in the spring. Indications of big construction activity in railway extension, electrical lines and business blocks look brighter as spring approaches. Contractor-dealers are already finding steady employment with new installations and a fair market for electrical materials.

Portland-Seattle One of the heaviest snowstorms in recent years visited the Northwest last week, creating considerable damage to electric lines in the Puget Sound District. Business was slowed up for a couple of days, but the week's volume was not materially changed. Sales continue active and prospects for a good year are most favorable. January jobbing business was about 15 per cent and central-station generation about 20 per cent ahead of a year ago. Although the lumber output is above normal, new business continues to lead production by at least 25 per cent. Copper is stiffening. The rather striking drop in porcelain knobs and tubes reported last week was apparently due to a temporarily competitive condition existing in this locality.

San Francisco Retail store business is improving. Building was slackened somewhat during storms early in the month, but present fine weather has brought it back toward the peak. Special attention is being paid to industrial exploitation in all large cities, and the steady though unobtrusive growth of the past ten years is now suddenly expanding very noticeably. Collections are still averaging somewhat over sixty days, but early improvement is expected. Stocks in general are well maintained, and there are few shortages because of the steady and well-assorted demand. Water shipments are increasing.

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Westinghouse Plans Large Chicago Warehouse

The Westinghouse Electric & Manufacturing Company is to erect a seven-story manufacturing and warehousing plant, 500 ft. x 240 ft., on West Pershing Road and Leavitt Street, Chicago. This construction work will be the largest in the central district since the erection of the four government warehouses in 1918. Besides the facilities for manufacturing switchboard panels and recharging equipment, this new building will serve as central and local distribution offices and eventually the sales offices for the Western territory. The building will consist of four units. The first, now under construction, will front 240 ft. on Pershing Road and extend back 130 ft. The concrete for the fifth floor is now being poured. Four thousand square feet of the second unit will also be built at the present time, although the entire second unit is not expected to be completed until 1924. This building will contain 960,000 sq.ft.

Ohio Brass Appointments

The Ohio Brass Company, Mansfield, Ohio, manufacturer of high-voltage porcelain insulators, announces that Thomas Jones, formerly with the Electric Appliance Company, has joined its sales force and will make his headquarters in Dallas, Tex. The company also announces that L. M. Keating, who has been connected with its home sales office for a number of years, has been transferred to outside sales and will have his headquarters in El Paso, Tex.

Correction of Error in Incandescent Lamp Suit Story

In the Feb. 17 issue of the ELECTRICAL WORLD, page 425, a statement appeared to the effect that the General Electric Company had been granted a preliminary injunction against P. R. Mallory & Company, Inc., Port Chester, N. Y., manufacturers of tungsten wire, and the Save Electric Corporation, Brooklyn, N. Y., manufacturer of incandescent lamps, which would have the effect of "preventing defendants from continuing the manufacture and sale of their products pending the final outcome of the litigation." It is found that this information was erroneous.

The facts are that the injunction under the Just and Hanaman patent was suspended ninety days as to both companies pending trial of the case, and that the injunction under the Langmuir patent was suspended as to the Save Electric Corporation pending the trial of the case in so far as relates to certain contracts with the city of Chicago and the state and city of New York.

As to P. R. Mallory & Company, Inc., furthermore, the proceedings have no effect upon any of its foreign sales or any of its business in contacts and other products. P. R. Mallory is restrained only from selling alleged tungsten wire for use in this country in the manufacture of the so-called "gas-filled incandescent electric lamps," which would constitute an infringement of claims 4, 5, 12 and 13 of the Langmuir patent.

Detweiler and Bell Incorporate as Manufacturers' Agents

Paul G. Detweiler and Stewart S. Bell have filed papers of incorporation in Connecticut as the Detweiler-Bell Company, manufacturers' agents, and will begin business March 1 in the Liberty Building, New Haven, Conn. This company will sell its products through jobbers.

Stewart Bell operated one of the first central stations in Massachusetts. He has been connected with the Westinghouse Electric & Manufacturing Company at Boston, with Stuart-Howland Company, Boston, and lately in Boston for the Moloney Electric Company. Paul G. Detweiler was district manager for the Franklin Electric Manufacturing Company at Hartford, Conn., and manager of lamp sales and illuminating engineering for the firm of Hessel & Hoppen Company, New Haven, Conn.

To Co-operate in Building Locomotives

Announcement has been made that the General Electric Company and the American Locomotive Company have effected an arrangement to co-ordinate their effort in the design and manufacture of electric locomotives for use on steam and electric railways.

The co-operation of the engineering and manufacturing facilities of these companies will doubtless result in improvements in design and construction and economies in manufacture and render improved service to railway companies. This arrangement between the two companies has been brought about in a large measure by the increased interest and business in railway electrification in the United States and abroad, particularly within the last year, and in anticipation of a large volume of work in the immediate future. A recent survey of the locomotive department of the Erie Works of the General Electric Company indicates that at present there are a larger number of orders from different customers than has been the case at any time since the beginning of the World War. Foreign business appears even more active than domestic. Spain, France, Chile, Japan, Mexico and South Africa are engaged in extensive projects, while other countries, including Italy and Great Britain, are seriously considering large-scale electrifications.

For a number of years the American Locomotive Company and the General Electric Company have collaborated in the development of electric locomotives. The Locomotive company has applied its knowledge and experience in the locomotive building art particularly to the design of the mechanical elements in the fabrication of which its manufacturing facilities were utilized, while the knowledge and experience of the General Electric Company were applied to the design of the electrical elements.

It is the satisfactory results of this collaboration which has led to the more formal relationship just announced, both companies believing that progress in the art can be most effectively assured by such means. The arrangement relates only to co-operation in design, development and manufacture and does not comprehend any financial relationships between the two companies.

Edward Miller Company Bought by Rex Cole and Associates

The well-known fixture firm of Edward Miller & Company, Meriden, Conn., has been purchased by Rex J. Cole and associates, and with it will be merged the Duplexalite Corporation and the Duplex Lighting Works of the General Electric Company, which will thus be discontinued as separate companies, the combined business being operated under the name of Edward Miller & Company of Meriden, Conn., with Rex J. Cole as president and Max Schwarz as vice-president and general manager.

Edward Miller, Jr., will continue as chairman of the board, and other officers are: Vice-presidents, Guy P. Norton and I. B. Miller; treasurer, Samuel McNabb; secretary, Hewitt Warburton; assistant secretary, L. A. Frost.

The Edward Miller company was founded in 1844, and in the early days manufactured oil lamps, later adding gas-lighting products, and finally entering the electrical field, where it has become one of the large manufacturers of portable lamps and lighting fixtures.

The Duplexalite offices in New York City will be discontinued and headquarters moved to Meriden. Meanwhile the Edward Miller offices on Park Place, New York, will be enlarged, and other branch offices will be maintained in Chicago, Cleveland and San Francisco.

Foreign Trade Notes

ELECTRICITY FOR EAST FLANDERS, BELGIUM.—Plans are being prepared by the commission recently appointed by the Provincial Council of East Flanders whereby the devastated districts will be supplied with electricity by next winter. Power will be supplied by the province and distributed by the communes to the consumers. Communes not located in the devasted regions will also be served.

PROPOSED ELECTRIC SYSTEM IN FRANCE.—Application for a concession to supply electricity for light and power in twenty-one communes in the Syndicat Intercommunal de Méligny-le-Grand, Department of the Meuse, has been made by the Compagnie Lorraine d'Electricité, Nancy. The Société Co-operative Agricole d'Electricité de la Region d'Hattencourt has petitioned for a concession to furnish electricity in twenty-three rural communes in the Hattencourt district, Somme Department. Application has also been made by another co-operative agricultural association for authority to supply electricity to thirty-two communes in the district of Montigny-sur-Halluce, in the same department. Steps which have been taken to develop the water power of the River Tinée in the Canton of Nice having proved successful, the Tinée Hydraulic Commission has reported favorably on the projects to develop the water power of the Saint-Etienne Laos, Bancairon and Corbaisse Falls. The work will be done by the Société de l'Energie Electrique du Littoral Mediterranéen. The scheme proposed by Lucien Neu and Louis Schowb, consulting engineers, Enghien, to develop 2,500 kw. on the River Doube for the city of Aesançon, to cost about 5,000,000 francs, has been adopted.

APPLICATION FOR CONCESSION TO SUPPLY ELECTRICITY IN THE YONNE AND NIEVRE DISTRICTS, FRANCE.—Application has been made by the Société d'Etudes des Chutes de la Cure et des Chemins de Fer Electriques de l'Yonne (Cure Falls and Yonne railway schemes) for a concession for the distribution of electricity for public service in the Yonne and Nièvre Departments. The concession includes the four departments of the Yonne, Nièvre, Côte-d'Or and Haute Marne. A power plant of 6,000 kw. capacity has already been built at Langres, and the concession includes the connection of this station with those of the Cure by a 60,000-volt transmission line. The cost of the project is estimated at 23,300,000 francs. Under the terms of the concession a minimum of 35 km. of railway line must be constructed within five years and 150 km. within ten years. As a result of these plans applications for state concessions have already been placed for a 20,000-volt transmission line from Sens to Auxerre by two companies, and for another extending from Langres to Chatillon-sur-Seine. Montbard, Cure and Auxerre. It has been decided to adopt the three-phase system.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Purchase is desired in France (No. 5,422) of electric automobile trucks.

Agency and purchase is desired in Italy (No. 5,481) for electric recording pyrometers, elapsed-time recorders, electric time switches, electric impulse clocks, water-level recorders and electric signal systems.

An agency is desired in Norway (No. 5,490) for cables and wires for power plants and electrical intallations.

WATER-TUBE BOILERS FOR POWER PLANT, SYDNEY, AUSTRALIA.—Tenders will be received until May 23 by the Railway Commissioners for eight water-tube boilers with accessories for the White Bay power house, Sydney, for the New South Wales government railways and tramways (Specification 575).

TELEPHONE EQUIPMENT FOR AUSTRALIA.—Tenders will be received by the Postmaster-General's Department, Melbourne, Australia, until April 10 for 686 tons of bronze wire and 500,000 paper jointing sleeves; also until April 17 for 595 timing clocks for trunk calls and 400,000 copper jointing sleeves. Tenders will be received by the Postmaster-General's Department, Adelaide, Australia, until April 18 for telephone apparatus.

ELECTRIC EQUIPMENT FOR PUMPING PLANT FOR BRISBANE, AUSTRALIA.—Tenders will be received by the Metropolitan Water and Sewerage Board, Brisbane, Australia, until June 26 for equipment for pumping plant, including a 140-kw., 440-volt direct-current electric generating unit.

TELEPHONE AND TELEGRAPH MATERIAL FOR TASMANIA. — Tenders will be received by the Postmaster-General's Department, Hobart, Tasmania, until April 9 for telegraph and telephone materials, including magneto bells, timing clocks, detectors, mouthpieces, lamps, etc.

PROPOSED EXTENSIONS TO THE MUNICIPAL ELECTRIC PLANT AT SHANGHAI, CHINA. — Plans are under consideration, according to *Commerce Reports*, to increase the output of the municipal electric plant at Shanghai, China, to 180,000 hp. The present capacity of the plant is said to be about 105,000 hp.

New Apparatus and Publications

ELECTRIC REFRIGERATOR. — A new household electric refrigerator outfit has been placed on the market by the Motorfrigerator Company, Lansdale, Pa.

HOUSEHOLD CABINET REFRIGERATOR.—The Universe Corporation, 341 East Ohio Street, Chicago, has placed on the market a new electric refrigerator, known as "Polaris."

PLURAL PLUG.—The Benjamin Electric Manufacturing Company, 847 West Jackson Boulevard, Chicago, has brought out a new edition of the No. 92 original two-way plug, known as the "One-to-two" plug.

AUTOMATIC TIME SWITCH.—An automatic time switch for henneries, known as the "Cackle" time switch, is being distributed by A. Hallberg, 73 Murray Street, New York City.

ELECTRIC FAN.—A new electric fan for household use has been placed on the market by the Kendrick & Davis Company, Lebanon, N. H.

ELECTRIC APPLE-PARING MACHINE.—An electric motor-driven apple paring and coring machine for hotels and restaurant kitchens has been placed on the market by the Goodell Company, Antrim, N. H.

ELECTRIC WAXER, SCRUBBER AND POLISHER. — A new machine has been developed by the Kent Company, Inc., Rome, N. Y., for sandpapering, scrubbing, waxing and polishing floors by electricity.

TIME SWITCH WITH CLOCK. — The Tork Company, 8 West Fortieth Street, New York City, has placed on the market a new time switch with clock, known as the "Tork Clock."

ELECTRIC WASHING MACHINE. — A new wringerless washing machine has been placed on the market by the Savage Arms Corporation, Utica, N. Y.

ELECTRIC HEATING PAD.—An electric heating pad, known as "Blue Bird," has been developed by the Charles Electric Garments Company, 1614 West Washington Street, Los Angeles, Cal.

FRACTIONAL-HORSEPOWER MOTORS.—A new line of fractional-horsepower motors of the split-phase type has recently been developed by the Robbins & Myers Company, Springfield, Ohio.

ELECTRIC REFRIGERATING MACHINE.—The Coldak Company, Springfield, Mass., is distributing a booklet in which it describes the new "Coldak" household electric refrigerating machine. This machine can be applied to any existing ice box.

New Incorporations

THE LINDALE (TEX.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $5,000 by R. F. Tarbrough, W. R. Eason and others.

THE APPOMATTOX (VA.) LIGHT & POWER COMPANY has been chartered with a capital stock of $25,000. The officers are C. A. Hancock, president, and C. W. Smith, secretary.

THE CONSOLIDATED POWER & LIGHT COMPANY, Huntington, W. Va., has been incorporated by C. L. S. Tingley, Walter W. Perkins and Henry P. Megaree, Philadelphia; W. R. Power and T. M. Hays, Huntington. The company is capitalized at $5,000,000 and proposes to take over the holdings of Consolidated Light, Heat & Power Company.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

MILO, ME. — Arrangements have been made whereby the transmission lines of the Milo Electric Light & Power Company and the Central Maine Power Company, Augusta, will be permanently connected for the purpose of an interchange of power.

PORTLAND, ME. — The Cumberland County Power & Light Company is reported to be considering doubling the capacity of its new steam-power plant at Knightville.

BOSTON, MASS.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 6, for 15,000 ft. of flexible conductor lighting and power wire, for the local navy yard (Schedule 523).

CAMBRIDGE, MASS.—Power equipment will be installed by the National Biscuit Company, Tenth Avenue, New York, in connection with its proposed local baking plant, to cost about $250,000.

NEW BEDFORD, MASS.—The installation of ornamental lamps on Borden, Anthony and Grove Streets is under consideration by the committee on street lights. The cost is estimated at $2,448.

WORCESTER, MASS.—A power plant will be built in connection with an addition to the Worcester Hahnemann Hospital, 261 Lincoln Street, to cost about $300,000. Kendall, Taylor & Company, 142 Berkley Street, Boston, are architects.

BRIDGEPORT, CONN.—The City Council is considering the installation of an ornamental lighting system on Broad Street and Stratford Avenue.

MERIDEN, CONN.—The local car barns and shops of the Connecticut Company were recently destroyed by fire, causing a loss of about $150,000.

NEW BRITAIN, CONN. — The question of improving the street-lighting system, especially in the outlying sections of the city, is under consideration by the Board of Public Works.

ROCKVILLE, CONN.—The Public Utilities Commission has instructed the Rockville-Willimantic Lighting Company to extend its electric lighting service through the villages of Forestville, West Stafford and Orcutts, the work to be completed by June 15.

TORRINGTON, CONN.—A petition has been presented to the Borough Council by the merchants and property owners for the installation of an ornamental lighting system in the business section of East Main, Water and South Main Streets.

WATERBURY, CONN. — Arrangements are being made by the Connecticut Light & Power Company for the erection of about 75 miles of high-tension transmission line for the distribution of electricity generated at its new plant, which is being constructed at Devon on the Housatonic River.

Middle Atlantic States

ALBANY, N. Y.—Electric power equipment will be installed in the addition to the plant of the Simmons Machine Company, 985 Broadway, to cost about $250,000.

BUFFALO, N. Y.—A luminous magnetite street-lighting system will be installed on Fillmore Avenue from Seneca to Best Street.

BUFFALO, N. Y.—The City Council has appropriated $10,000 for the installation of overhead electric traffic controls for use in regulating the traffic on Main Street.

ITHACA, N. Y.—The Associated Gas & Electric Company, operating the Ithaca Gas & Electric Company and other utility properties, contemplates increasing its capital from 150,000 shares to 210,000 shares, no par value, the proceeds to be used for extensions and improvements.

NEW YORK, N. Y.—The National Biscuit Company, Tenth Avenue and Fifteenth Street, plans to build a power house to cost about $150,000.

NEW YORK, N. Y.—Bids will be received by the Superintendent of Light Houses, Staten Island, until Feb. 26, for six switchboards (Proposal 14,220).

NIAGARA FALLS, N. Y.—G. A. Strain, receiver for the Niagara Falls Gas & Electric Company, is planning extensions and improvements.

POTSDAM, N. Y.—A power plant will be built in connection with the proposed paper mill to be built by a company now being organized by Hollis W. Martin, Norwood, N. Y. It will cost about $110,000. T. L. Tomlines, City Bank Building, Syracuse, is engineer.

WATERTOWN, N. Y.—The proposal to issue $265,000 in bonds to develop the water power at Delano Falls for municipal purposes will be submitted to the voters on Feb. 24.

DELAWARE, N. J.—The Metropolitan-Edison Company is preparing plans for a hydro-electric power plant, to cost about $750,000.

SUMMIT, N. J.—Bids will be received by the Board of Education until March 5 for electric work and equipment in the proposed addition to the Washington School, North Summit. P. W. Lyall is secretary of the board.

DRUMS, PA.—The Pennsylvania Power & Light Company will build a transmission line from Kis-Lyn to Drums, also from White Haven to Mountain Top.

KITTANNING, PA. — Plans are being drawn for a power house at the local Community Hospital, in connection with a new hospital building to cost $250,000. Crow, Lewis & Wick, 200 Fifth Avenue, New York, are architects.

NEW CASTLE, PA.—The Carnegie Steel Company, Pittsburgh, will build an addition to its local power house, including improvements in the present plant, to cost about $200,000.

OIL CITY, PA. — The Penn-American Refining Company will build a power plant at its local works, to cost $95,000. The Rust Engineering Company, 311 Ross Street, Pittsburgh, is engineer.

SHAMOKIN, PA. — The Pennsylvania Power & Light Company contemplates extending its service to Gowen City in the spring.

ZELIENOPLE, PA.—Electrically operated pumping machinery and other motor-driven equipment will be installed in connection with the proposed water filtration plant, to cost about $150,000. Hudson & Myron, Wabash Building, Pittsburgh, are engineers.

HUNTINGTON, W. VA.—The Consolidated Power & Light Company, recently organized to take over property of the Consolidated Light, Heat & Power Company, plans extensions to the system.

WASHINGTON, D. C.—Bids will be received by the Supervising Architect, Treasury Department, until March 2 for the furnishing and installing electric lighting fixtures in the post offices at Apalachicola, Fla.; Charleston, W. Va.; Eureka, Utah; Front Royal, Va.; Vinton, Iowa, and the United States post office and court house at Buffalo, N. Y.

North Central States

BAY CITY, MICH.—Bids will be received by the Water Commissioners until March 5 for electric and power wiring, heating and ventilating, etc., for the waterworks plant, to cost about $150,000. Frazier, Sheal & Ellms, B. F. Keith Building, Cleveland, are engineers.

DETROIT, MICH. — The Detroit-Edison Company contemplates the erection of a new steel-tower transmission line.

LIMA, OHIO. — The Lima Locomotive Works contemplates rebuilding the portion of its power plant, recently destroyed by fire, with a loss of about $30,000.

MARIETTA, OHIO.—Work has started on the installation of a new turbo-generator and boilers in the Riverside plant of the Monongahela Power & Traction Company.

CHAMPAIGN, ILL.—Improvements are contemplated by the Urbana & Champaign Railway, Gas & Electric Company during 1923, to cost about $40,000.

BIRON, WIS.—Failing to make satisfactory arrangements with the city authorities of Stevens Point, the Consolidated Water Power & Paper Company has decided to locate in Biron. It will erect a two-story building, oxer 400 ft. long, to house its plant. Plenty of power is available here, but electrical equipment will be necessary to connect the hydro-electric units with the new equipment.

COON VALLEY, WIS.—The Coon Valley Electric Company plans to rebuild its entire lighting system, including changing the service from direct to alternating current. New equipment, including switchboard, motors, transformers and generator, will be required.

DOUSMAN, WIS.—The plant and holdings of the Dousman Electric Light & Power Company have been purchased by the Milwaukee Electric Railway & Light Company. Extensions and improvements, it is understood, will be made to the local system by the purchasing company.

EAU CLAIRE, WIS. — The Wisconsin-Minnesota Light & Power Company contemplates the purchase of heavy copper wire (to cost about $45,000) to be used on its high-tension transmission line between the hydro-electric plant at Wissota and Stillwater, Minn. It is proposed to increase the wires on the towers from four to seven.

EVANSVILLE, WIS.—The Council has decided to install an ornamental lighting system, consisting of thirty-six standards, during the coming year.

MILWAUKEE, WIS. — Preparations are being made by the Milwaukee Electric Railway & Light Company for the erection of a high-tension transmission line between Vernon and Big Bend.

MILWAUKEE, WIS.—Backes & Pfaller, 217 West Water Street, architects and engineers, have been engaged to prepare plans for a five-story hospital addition, a boiler house and power plant and other buildings, for the Misericordia Hospital, 2224 Chestnut Street. New equipment, including boilers, engine, generators, ice machinery, etc., will be required. The cost is estimated at $165,000.

ONTARIO, WIS.—Negotiations are under way between the Ontario Electric Light & Milling Company and the City Council for extension to the street-lighting system.

WAUSAU, WIS.—The committee on lighting has recommended to the City Council the installation of street lamps at numerous intersections in the city.

LITTLE FALLS, MINN. — The Little Falls Water Power Company contemplates the erection of a transmission line from Lastrup to Onamia, Wahkon and Isle.

MINNEAPOLIS, MINN.—The South Minnesota Gas & Electric Company has issued $1,750,000 in bonds, part of the proceeds to be used for extensions and improvements.

RED WING, MINN.—Bids, it is reported, will soon be asked for the installation of a municipal electric power plant, to cost about $350,000.

MUSCATINE, IOWA — Bids, it is reported, will be called in March for the construction of a municipal electric power plant. Arthur L. Mullergren, Firestone Building, Kansas City, Mo., is engineer.

SIOUX CITY, IOWA.—The Sioux City Gas & Electric Company is planning to place all wires in the downtown business section of the city underground. Arrangements are also being made by the company to supply electricity in about seventy-five towns in northwestern Iowa. The erection of the transmission lines to furnish the service is already under way.

PLEASANT HILL, MO.—The West Missouri Power Company contemplates extensions and improvements to its system, including the installation of new equipment. The company recently increased its capital from $750,000 to $1,400,000.

ST. JOSEPH, MO. — Electric power equipment will be installed at the proposed woodworking plant of the Collier-Adams Manufacturing Company, Fourth Street and Mitchell Avenue, to cost about $100,000.

ST. LOUIS, MO.—Bonds to the amount of $8,000,000 has been voted for the installation of a street-lighting system in all parts of the city; also $1,000,000 for a municipal electric power plant and mechanical building for civic service. W. Frank Carter is chairman of the committee on civic needs.

ST. LOUIS, MO.—Contracts will soon be awarded for prism lamps and concrete standards on Watson Road and Clara Avenue, to cost about $35,000. R. Toensfeldt is city engineer.

FREDONIA, KAN.—An election will be held on Feb. 27 to vote on the proposal to issue $150,000 in bonds to establish a municipal electric light and power plant. C. R. Schiek is engineer.

KANORADO, KAN. — Bonds to the amount of $25,000 have been voted for the installation of a local electric distributing system and a transmission line. W. B. Rollins & Company, Railway Exchange Building, Kansas City, Mo., are engineers.

LEAVENWORTH, KAN.—Elecceric power equipment will be installed at the local plant of the Bonner Portland Cement Company, Kansas City, Mo., in connection with extensions and improvements, to cost about $1,500,000.

LEAVENWORTH, KAN.—A power house to cost about $35,000 will be erected at the new public school on Third Avenue, to cost about $110,000. The Board of Education is in charge.

WASHINGTON, KAN.—The installation of an ornamental lighting system in the business district is under consideration.

WICHITA, KAN.—The Derby Refining Company will install electric power equipment in connection with additions to its local oil refinery, to cost about $300,000.

Southern States

CLINTON, N. C.—The Tidewater Power Company, Wilmington, will build a transmission system to Clinton, by way of Warsaw, about 68 miles, to cost about $130,000.

MOUNT AIRY, N. C. — Electric power equipment will be installed in the proposed ice-manufacturing and refrigerating plant to be erected by the Carolina-Virginia Growers' Association. J. B. Sparger is president.

MURPHY, N. C. — The North Carolina Iron & Mining Company, Andrews, will install electric power and mechanical equipment for a new washing and crushing plant at its properties.

ROUGEMONT, N. C.—W. A. Carver is making inquiries for a generator, 75 hp. to 100 hp.

GREAT FALLS, S. C. — The Republic Cotton Mills, Inc., will build a power house, 42 ft. x 47 ft., in connection with a new mill, to cost about $450,000. J. E. Sirrine & Company, Greenville, are engineers.

MOLINO, FLA. — The Jacobi Lumber Company contemplates rebuilding its lumber works, including planing mill and power house, recently destroyed by fire, causing a loss of about $200,000.

BRISTOL, TENN.—A bill has been presented to the State Legislature by Senator D. A. Barger authorizing the city of Bristol to issue $500,000 in bonds for the purpose of establishing a municipal electric light plant.

KNOXVILLE, TENN. — The Cherokee Spinning Company will install a substation at its proposed mill to cost about $400,000.

NASHVILLE, TENN. — The Hermitage Portland Cement Company, Chattanooga, will build a power house at its proposed local plant, to cost about $500,000.

PARIS, TENN.—Extensions and improvements to the municipal electric light and water plant, to cost about $100,000, are under consideration. W. J. Holman is manager.

ATHENS, ALA.—Electric power equipment will be installed in the ice-manufacturing and refrigerating plant to be built by the Athens Ice & Coal Company, for which plans have been prepared.

COLLINSVILLE, ALA. — The Collinsville Light & Power Company contemplates extensions to its plant, including the installation of new equipment.

SAMSON, ALA.—The municipal electric light and water plant has been purchased by the Pea River Power Company, Troy. The new owners will take over the property at once and will erect a transmission line from Elba to supply electricity to operate the local system.

OXFORD, MISS.—Bids will be received by the Board of Aldermen and Mayor until March 15 for an engine, generator and switchboard equipment for the municipal electric and water plant. Proposals will be received for either oil-engine or steam-engine equipment. T. M. Early is superintendent of water and light plant.

BEAUMONT, TEX.—The Beaumont Sash & Door Company will install electric power equipment in connection with its proposed local plant, to cost about $65,000.

CORPUS CHRISTI, TEX.—Plans are under consideration for the installation of a municipal underground conduit system.

DALLAS, TEX.—Bids will be asked at once for the installation of an ornamental lighting system on Jefferson Street, Oak Cliff section.

Pacific and Mountain States

EPHRATA, WASH. — The Washington Water Power Company contemplates the election of a transmission line to Quincy, about 18 miles.

OLYMPIA, WASH. — A franchise has been granted to Charles G. Hawson, Olympia, for the erection of a transmission line in the Pleasant Glade district for commercial light and power service.

SEATTLE, WASH.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 13, for 7,300 ft. of telephone cable for use at the local navy yard (Schedule 521); bids will also be received for 3,600 ft. of fiber conduit and 2,200 ft. wood conduit (Schedule 522).

SEATTLE, WASH.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 14, for one electric traveling crane for use at the local navy yard (Specification 4755).

WENATCHEE, WASH.—The Wenatchee Placer Gold Mining Company contemplates the installation of a power plant at its properties.

ASTORIA, ORE.—The Union Oil Company, San Francisco, Cal., will build a power house in connection with its proposed local oil plant, to cost about $500,000.

LOS ANGELES, CAL.—Ordinances have been approved providing for the installation of street-lighting systems on Pacific Avenue, Seventh and Fourteenth Streets, San Pedro district.

LOS ANGELES, CAL.—The installation of an ornamental lighting system on Arden Boulevard and on El Centro Avenue is under consideration.

LOS ANGELES, CAL.—A power house will be erected by the Mexican Petroleum Company, 120 Broadway, New York, in connection with its proposed refining plant in the San Pedro section, to cost about $6,000,000.

LOS ANGELES, CAL.—Ordinances have been approved for the installation of ornamental lighting systems on Canal Avenue, from Anaheim to D Street, and on Washington Street, from Hobart Boulevard to Eighth Avenue.

PITTSBURG, CAL. — Electric power equipment will be installed in the proposed addition to be erected by the Columbia Steel Corporation, consisting of five buildings, to cost about $200,000.

SAN DIEGO, CAL.—Plans for the proposed cotton mill to be erected in San Diego by the California-Pacific Textiles, Inc., to cost about $600,000, include a power plant. W. A. Golden is president.

VENICE, CAL.—The Council is considering the installation of an electrical distributing system, to cost about $100,000.

ASPEN, COL.—The Belle Marie Mining & Milling Company is planning to build a new plant in the spring, including mining and mill buildings, and power house, to cost about $275,000. A. J. Petelinz, 426 Grand Avenue, Milwaukee, is architect.

CANON CITY, COL.—Improvements will be made to the boiler room of the local plant of the Southern Colorado Power Company, to cost about $20,000.

DENVER, COL.—Bids will be received at the office of the United States Reclamation Service, Denver, until March 13, for one 1,000 kva., vertical alternating-current generator, complete with exciter; four 333 kva., single-phase, self-cooled transformers; three 10 kva. single-phase, self-cooled transformers; switching apparatus, etc.

ROSWELL, N. M.—The City Council is considering the purchase of the plant of the Roswell Public Service Company, to be owned and operated by the municipality.

Canada

VANCOUVER, B. C.—The British Columbia Electric Company has purchased a site for an addition to power plant of its subsidiary, to cost about $90,000.

PETERBORO, ONT. — The Hydro-Electric Power Commission of Ontario is preparing plans for the development of the water powers of dams Nos. 8 and 9 on the Trent River, which will be used to augment the power supply of Peterboro.

STOUFFVILLE, ONT.—A committee has been appointed to negotiate with the Hydro-Electric Power Commission of Ontario with a view of securing hydro-electric service for this village. A transmission line (11 miles long) to connect with the Yonge Street line would have to be erected.

TIMMINS, ONT.—An agreement has been reached between the Ontario government and the Hollinger Mining Corporation whereby the latter will begin work on the construction of a hydro-electric development at Island Falls. The plans provide for a development of 16,000 hp. at a cost of about $3,000,000.

QUEBEC, QUE.—An additional power development of 7,500 hp. is reported to be under consideration by Price Brothers & Company, Ltd.

Electrical Patents

Announced by U. S. Patent Office

(Issued Feb. 6, 1923)

1,444,425. ELECTRIC REGULATOR FOR INTERNAL-COMBUSTION ENGINES; H. Ogden, Westcliff-on-Sea, England. App. filed May 22, 1922. Control of engine driving welding generator prevents excessive sudden loads.

1,444,434. INSULATOR SUPPORTING PIN; L. Steinberger, Brooklyn, N. Y. App. filed Nov. 6, 1918. Cross-arm pin having coiled spring for screwing into insulator.

1,444,438. ELECTRODE STRUCTURE; W. C. White, Schenectady, N. Y. App. filed Aug. 7, 1918. Construction of grids for electron discharge relays or amplifiers of pliotron type.

1,444,454. LAMP SOCKET; W. L. Brooks, Schenectady, N. Y. App. filed Oct. 27, 1920. When lamp is withdrawn circuit is automatically closed through socket.

1,444,458. DYNAMO-ELECTRIC MACHINE; V. H. Greisser, Spokane, Wash. App. filed Oct. 21, 1921. Method of ventilation.

1,444,494. SILENCER FOR TELEPHONES; S. T. Cohane, Hartford, Conn. App. filed Feb. 15, 1922. Attachment for transmitter to cut out extraneous sounds.

1,444,495. ELECTRIC MOTOR; C. Z. Coleman, San Francisco, Cal. App. filed Oct. 28, 1921. Laminated core rotor.

1,444,524. MAGNETIZING DEVICE; E. S. Pridham and P. L. Jensen, Oakland, Cal. App. filed April 28, 1920. Device for making permanent magnets without breaking magnetic circuit.

1,444,555. TELEGRAPH RELAY; C. J. Rogers, Morris, Okla. App. filed Feb. 7, 1920. Differentially wound transmitting coils for use on "leaky" lines.

1,444,561. ELECTRIC BATTERY HEATER; J. E. Schraeder, Crookston, Minn. App. filed Jan. 12, 1922. Device for heating storage batteries before dismantling them for repairs.

1,444,584. ELECTRIC FURNACE HAVING RESISTOR DOME; G. H. Clamer, Atlantic City, and J. R. Wyatt, Camden, N. J. App. filed Nov. 20, 1920. Utilizes both reflected and radiated heat from upper furnace walls.

1,444,605. CARRIER-WAVE SIGNALING SYSTEM; R. A. Heising, Millburn, N. J. App. filed Jan. 21, 1919. Method of signaling through successively modulated currents.

1,444,620. AIR-MOTOR-DRIVEN GENERATOR; E. Lunn, Chicago, Ill. App. filed Sept. 12, 1921. Wind-driven generator for charging airplane batteries.

1,444,621. ELECTRIC HEATER; L. F. Lynn and J. D. Lewis, Tacoma, Wash. App. filed Feb. 16, 1922. Air preheated by passing through shell surrounding element before coming into contact with element.

1,444,685. SIGNALING SYSTEM AND RELAY THEREFOR; R. M. Hopkins, Rutherford, N. J. App. filed July 5, 1919. Burglar-alarm system for vaults.

1,444,716. TROLLEY WHEEL; A. C. Van Hooydonk, Monroe, Mich. App. filed May 12, 1922. Two wheels mounted on movable hub.

1,444,742. SIGNAL; F. Guenther, San Mateo, Cal. App. filed Jan. 18, 1921. Alarm to indicate to automobile driver that doors are not properly closed.

(Issued Feb. 13, 1923)

15,538 (reissue). CONTROL DEVICE FOR WIRELESS SIGNALING; E. H. Colpitts, East Orange, N. J. App. for reissue filed Feb. 14, 1918. Current flows in amplifier tubes only during time signal impulses are sent.

15,539 (reissue). TELEGRAPHY; T. B. Dixon; New York, N. Y. App. for reissue filed May 3, 1922. Amplifying telegraphic signals transmitted through cables.

15,540 (reissue). MEANS FOR TRANSFORMING MECHANICAL VIBRATIONS INTO ELECTRICAL VIBRATIONS; L. de Forest, New York, N. Y. App. for reissue filed July 13, 1921. By thermionic tubes.

1,444,777. IMPULSE TRANSMITTER FOR AUTOMATIC TELEPHONE SYSTEMS; J. G. Blessing, Chicago, Ill. App. filed Jan. 26, 1920. Subscriber compelled to remove his finger before dial returns to normal position.

1,444,781. TELEPHONE EXCHANGE SYSTEM; G. Deakin, London, England. App. filed May 26, 1919. Call metering device for automatic telephone system.

1,444,787. ELECTROLYTIC APPARATUS; W. E. Greenwalt, Denver, Col. App. filed June 11, 1920. For the production of hydrogen sulphide and sponge lead.

1,444,804. PUSH-BUTTON SWITCH; F. Sauczuk, Brooklyn, N. Y. App. filed Dec. 8, 1919. For apartment-house annunciators.

1,444,805. VOICE-CURRENT TELEPHONE REPEATER; A. B. Smith, Evanston, Ill. App. filed March 5, 1919. Method of switching voice-current amplifier from trunk line to repeat in one direction to connections which adapt it in opposite direction.

1,444,827. CONTROLLING SYSTEM FOR MINE-BLASTING OPERATIONS; S. F. Bridwell and J. F. Kennedy, Terre Haute, Ind. App. filed May 25, 1921. For selectively firing blasts within mine by electricity.

1,444,830. TRANSMISSION CONTROLLING APPARATUS; C. S. Demarest, Brooklyn, N. Y. App. filed Aug. 9, 1919. For controlling operation of four-wire repeater circuits.

1,444,858. SWITCH BOX; G. B. Wadsworth, Covington, Ky. App. filed Oct. 11, 1917. Safety box in which switch must be turned before exposing fuses.

1,444,886. SPEED INDICATOR FOR AËROPLANES; E. W. Rounds, Washington, D. C. App. filed July 30, 1921. Chronograph for recording the ground speed of aëroplane while taking off or landing.

1,444,887. METHOD OF PRODUCING PURE IRON BY ELECTROLYSIS; A. Schwiete, Frankfort-on-Main, Germany. App. filed May 31, 1922. Electric current acts on slightly acidulated solution of ferrous chloride.

1,444,939. ELECTRIC FURNACE; T. A. Reid, Pittsburgh, Pa. App. filed April 25, 1921. Support of resistances in furnaces.

1,444,940. RESISTOR-SUPPORTING MEANS; T. A. Reid, Pittsburgh, Pa. App. filed June 3, 1921. For electric furnace.

1,444,947. CONTROL APPARATUS; A. H. Candee, Pittsburgh, Pa. App. filed Oct. 30, 1918. Emergency braking equipment for electric railway vehicles.

1,444,948. ELECTRIC FURNACE; C. H. Carpenter, Wilkinsburg, Pa. App. filed April 23, 1920. Container for the material acts as resistor.

1,444,958. ELECTRIC HEATER; F. W. De Luchi, Oakland, Cal. App. filed Feb. 13, 1922. Electric room heater.

1,444,961. ARC-LAMP ELECTRODE; H. B. Eynon, Lakewood, Ohio. App. filed June 11, 1919. Negative projector electrode composed of three forms of carbon.

1,444,962. ARC-LAMP ELECTRODE; H. B. Eynon, Lakewood, Ohio. App. filed June 11, 1919. Negative projector electrode consisting of carbon shell, graphite core and intermediate filling of powdered graphite.

1,444,980. ELECTRIC FURNACE; W. E. Moore, Beaver; H. F. Alter and E. A. Hanff, Pittsburgh; J. R. Eckley, New Kensington, Pa., and F. Wright, Newport, Ky. App. filed Sept. 5, 1919. Electric arc furnace of rocking type.

1,444,983. TROLLEY BASE; W. Schaake, Pittsburgh, Pa. App. filed Oct. 9, 1920. Construction of trolley-pole base.

1,445,019. ELECTRIC WATER HEATER; J. Joeschke, Berlin, Germany. App. filed May 5, 1922. Connected directly to water faucet.

1,445,025. STORAGE-BATTERY SYSTEM; S. E. McFarland, Los Angeles, Cal. App. filed Nov. 5, 1919. Any portion of battery can be used while charging.

1,445,072. TERMINAL BOX; W. L. Cook, Chicago, Ill. App. filed Nov. 20, 1919. Telephone board for use with underground cables.

1,445,089. TROLLEY GUARD AND FINDER; P. J. Kelley, Detroit, Mich. App. filed Oct. 23, 1922. Enables quick raising of pole into contact with wire.

1,445,120. MULTIPLE INCANDESCENT ELECTRIC LAMP; N. Wise, New York, N. Y. App. filed Feb. 7, 1919. When one filament is burned out second is used.

1,445,141. SIGNALING SYSTEM; B. W. Kendall, New York, N. Y. App. filed Dec. 18, 1916. Multiplex telephony by means of modulated carrier currents.

1,445,149. FLOOR-LEVEL STOP FOR ELECTRICALLY OPERATED ELEVATORS; E. R. Leigh, Philadelphia, Pa. App. filed Sept. 22, 1917.

1,445,169. DENTAL FILM HOLDER; H. G. Ralph, Edenton, N. C. App. filed Feb. 14, 1921. For holding X-ray films.

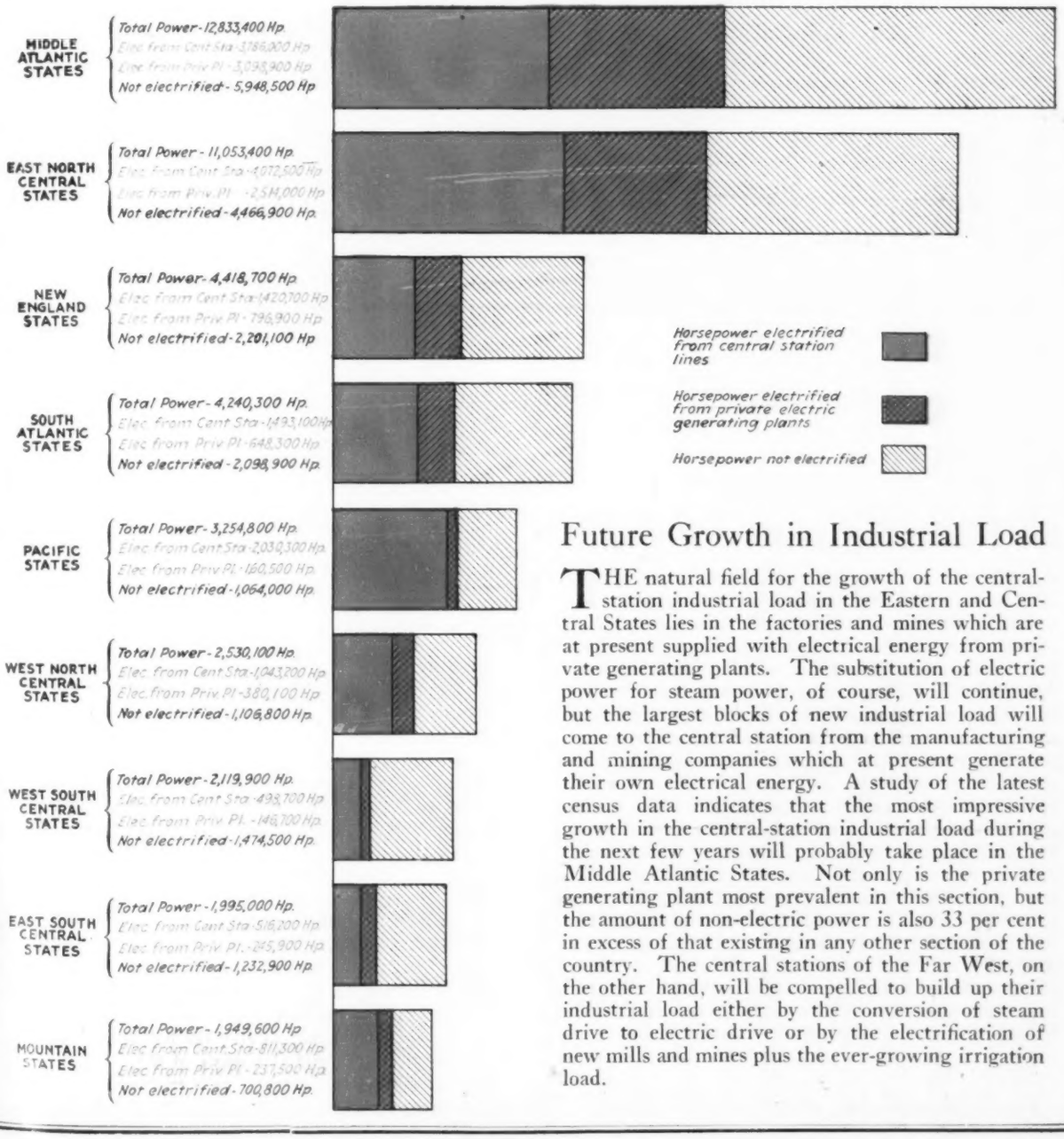
1,445,178. FEEDER CLAMP FOR OVERHEAD-TROLLEY SYSTEMS; P. G. Schwarz, Indianapolis, Ind. App. filed Dec. 22, 1919.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

Extent to Which the Mills, Factories and Mines of the Various Sections of the Country Are Electrified

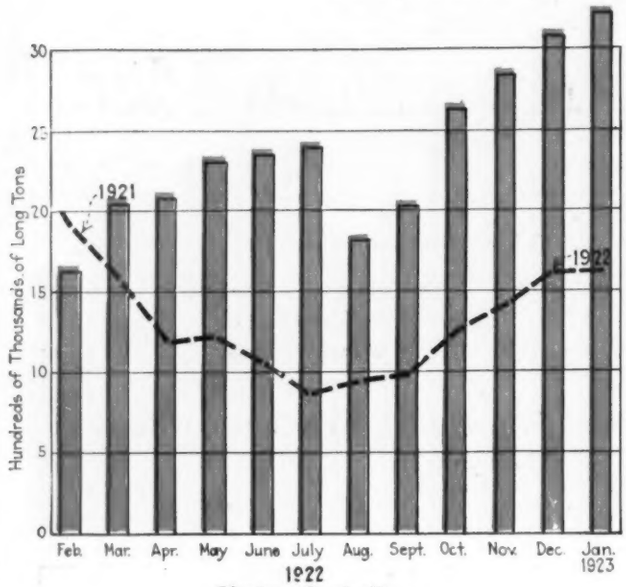
(Data as of Jan. 1, 1920)


MIDDLE ATLANTIC STATES
Total Power - 12,833,400 Hp.
Elec. from Cent. Sta. - 3,786,000 Hp.
Elec. from Priv. Pl. - 3,098,900 Hp.
Not electrified - 5,948,500 Hp.
EAST NORTH CENTRAL STATES
Total Power - 11,053,400 Hp.
Elec. from Cent. Sta. - 4,072,500 Hp.
Elec. from Priv. Pl. - 2,514,000 Hp.
Not electrified - 4,466,900 Hp.
NEW ENGLAND STATES
Total Power - 4,418,700 Hp.
Elec. from Cent. Sta. - 1,420,700 Hp.
Elec. from Priv. Pl. - 796,900 Hp.
Not electrified - 2,201,100 Hp.
SOUTH ATLANTIC STATES
Total Power - 4,240,300 Hp.
Elec. from Cent. Sta. - 1,493,100 Hp.
Elec. from Priv. Pl. - 648,300 Hp.
Not electrified - 2,098,900 Hp.
PACIFIC STATES
Total Power - 3,254,800 Hp.
Elec. from Cent. Sta. - 2,030,300 Hp.
Elec. from Priv. Pl. - 160,500 Hp.
Not electrified - 1,064,000 Hp.
WEST NORTH CENTRAL STATES
Total Power - 2,530,100 Hp.
Elec. from Cent. Sta. - 1,043,200 Hp.
Elec. from Priv. Pl. - 380,100 Hp.
Not electrified - 1,106,800 Hp.
WEST SOUTH CENTRAL STATES
Total Power - 2,119,900 Hp.
Elec. from Cent. Sta. - 498,700 Hp.
Elec. from Priv. Pl. - 146,700 Hp.
Not electrified - 1,474,500 Hp.
EAST SOUTH CENTRAL STATES
Total Power - 1,995,000 Hp.
Elec. from Cent. Sta. - 516,200 Hp.
Elec. from Priv. Pl. - 245,900 Hp.
Not electrified - 1,232,900 Hp.
MOUNTAIN STATES
Total Power - 1,949,600 Hp.
Elec. from Cent. Sta. - 811,300 Hp.
Elec. from Priv. Pl. - 237,500 Hp.
Not electrified - 700,800 Hp.
Horsepower electrified from central station lines
Horsepower electrified from private electric generating plants
Horsepower not electrified

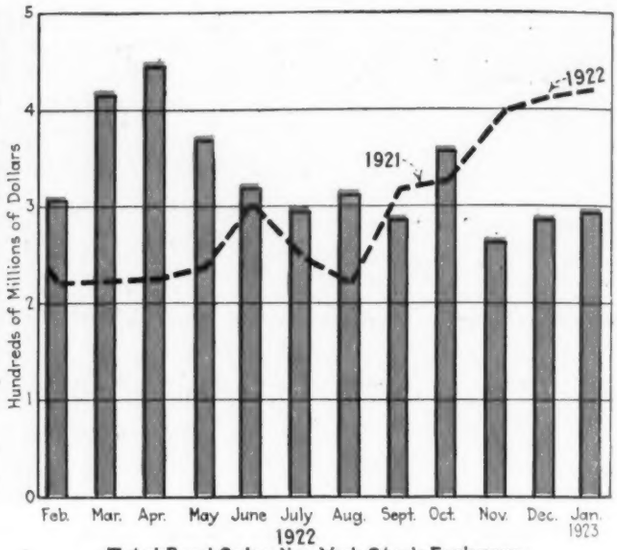
Future Growth in Industrial Load

THE natural field for the growth of the central-station industrial load in the Eastern and Central States lies in the factories and mines which are at present supplied with electrical energy from private generating plants. The substitution of electric power for steam power, of course, will continue, but the largest blocks of new industrial load will come to the central station from the manufacturing and mining companies which at present generate their own electrical energy. A study of the latest census data indicates that the most impressive growth in the central-station industrial load during the next few years will probably take place in the Middle Atlantic States. Not only is the private generating plant most prevalent in this section, but the amount of non-electric power is also 33 per cent in excess of that existing in any other section of the country. The central stations of the Far West, on the other hand, will be compelled to build up their industrial load either by the conversion of steam drive to electric drive or by the electrification of new mills and mines plus the ever-growing irrigation load.

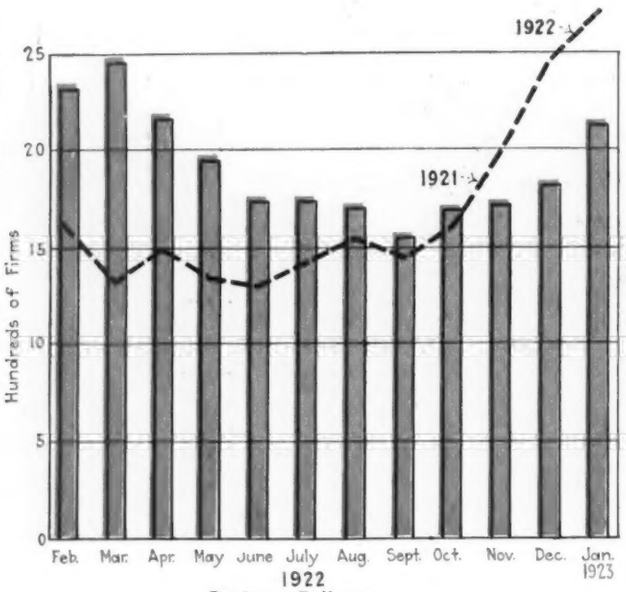
How the Primary Industries Are Trending



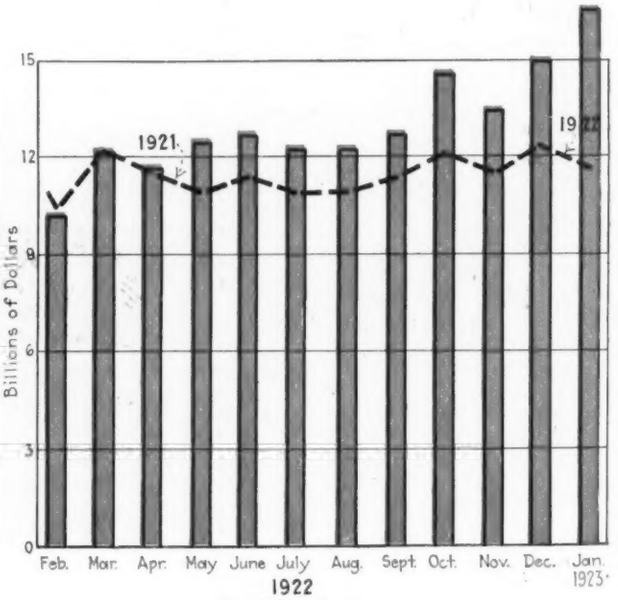
Pig-iron Production



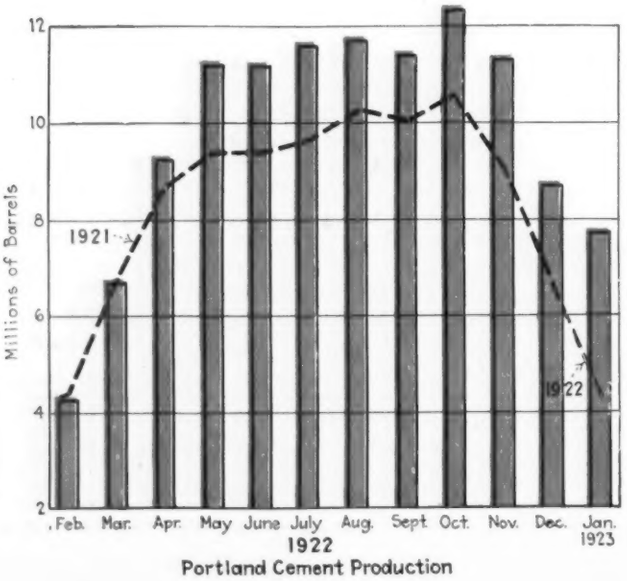
Total Bond Sales, New York Stock Exchange



Business Failures



Bank Clearings
(Outside of New York City)



Portland Cement Production

Bank Clearings Indicate Prosperous Conditions

ONE of the most significant indices of general prosperity during January was the unusual bank clearings reported for that month. Many prominent economists and statisticians consider bank clearings outside of New York City as the most reliable barometer of the growth of American business. The figure of $16,562,000,000 reported for January represents the largest bank clearings outside of New York City reported since March, 1920, and data available indicate that it is the third largest figure ever reported for any one month. The January clearings increased 42.5 per cent over January, 1922.

Pig-iron production continued to climb during January, being almost double the production reported for January last year. A study of the growth in pig-iron production for many years in the past indicates that the production during January was about 5 per cent higher than the production which would normally be expected for that month.